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LISTS OF SPECIES

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Brazilian tropical fishes in their southern limit of distribution: checklist of Santa Catarina's rocky reef ichthyofauna, remarks and new records

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Abstract: We present a checklist of 278 species of reef fishes recorded along the coastline of Santa Catarina state, the southernmost limit of distribution of tropical ichthyofauna on the coast of Brazil. Twelve new species records for this state are presented: *Acanthurus coeruleus, Acanthurus monroviae, Apogon americanus, Cantherhines macrocerus, Chaetodon sedentarius, Chromis flavicauda, Clepticus brasiliensis, Decapterus punctatus, Gymnothorax vicinus, Herpetoichthys regius, Muraena retifera* and *Stegastes partitus*. *Stegastes partitus* and *H. regius* are reported for the first time, respectively, from the Southwestern Atlantic and for the coastal part of this region, while *Acanthurus monroviae* is reported for the second time for the Southwestern Atlantic. We present habitat distribution, trophic structure and comment on biogeographic affinities of this transitional region, discussing both remarkable species presences and absences.

Key words: rocky reefs, Southwestern Atlantic Shelf, Teleostei, Elasmobranchii, Atlantic Subtropical Convergence, upwelling

INTRODUCTION

The Brazilian reef ichthyofauna has been subject to considerable research in the past 30 years. This was especially due to the popularization of scuba diving among Brazilian scientists, and to the improvements in genetics and computational power (Floeter et al. 2001; Rocha et al. 2008; Bernardi et al. 2013; Pita et al. 2014). However, this region still remains poorly studied in comparison to other biogeographic provinces in the world (Floeter et al. 2001).

The south and southeastern Brazilian coastline is characterized by granitic rocky reefs influenced by both warm tropical waters from the Brazil Current and cool waters from the South Atlantic Central Water (SACW). This water mass intrudes on the shallow coastal shelf of this region (Acha et al. 2004), especially during spring and summer northeastern winds, and features temperatures of ≤16°C (Carvalho et al. 1998). In the southernmost part of the Brazilian coast, the cold La Plata Plume Water (PPW) coming from the discharge of the La Plata River (at 35°S) reaches coastal areas during the winter (Möller Jr. et al. 2008). The low temperatures generated by these water masses affect the distribution of tropical marine organisms in the region (Boschi 2000; Floeter et al. 2001, 2008; Spalding et al. 2007; Barneche et al. 2009; Anderson et al. 2014a, 2014b), precluding some of them from establishing southwards. Mangrove forests (Sobrinho et al. 1969), corallith (Capel et al. 2012) and rhodolith beds (Gherardi 2004; Pascelli et al. 2013) are biological features of the landscape that reach their southern limit of distribution in the Southwestern Atlantic, precisely in the state of Santa Catarina. Coincidently, this state also represents the southern limit of occurrence of rocky reefs, with a large stretch of sandy beaches extending from it almost continuously to Uruguay. Therefore, for fishes and other organisms that inhabit hard substrates, Santa Catarina is the southernmost limit of the Brazilian biogeographic province (Floeter et al. 2008; Briggs and Bowen 2012).

There are recent taxonomic inventories from São Paulo (Luiz et al. 2008) and Paraná (Hackradt and Félix-Hackradt 2009) states in Brazil, as well as from the coast of Patagonia, in Argentina (Galván et al. 2009). However, despite its biogeographic importance, taxonomic knowledge on Santa Catarina reef fishes remains largely outdated (e.g., Lema 1976; Lema et al. 1980; Godoy

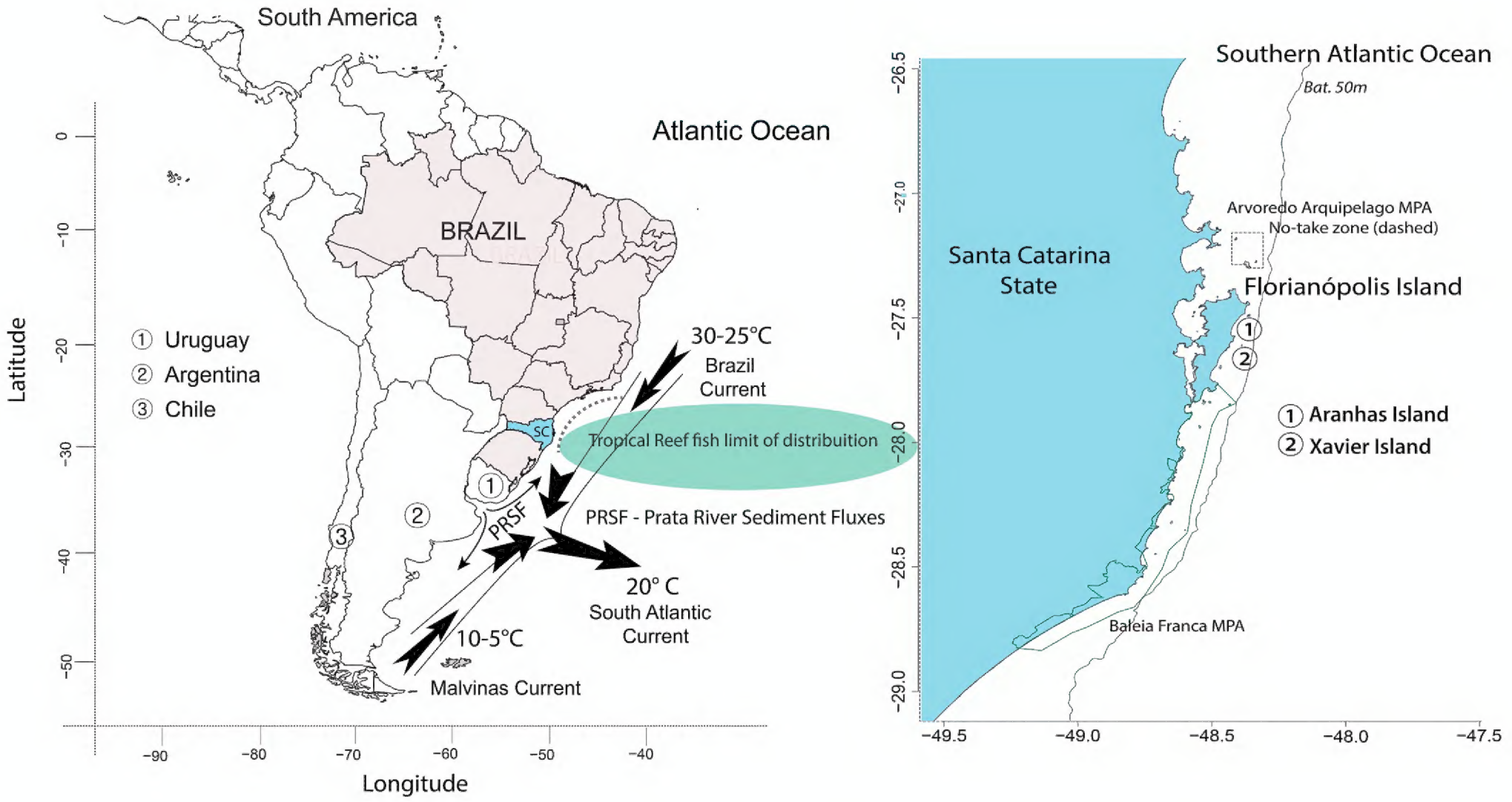

Figure 1. Map of South America showing the influence of both warm tropical and cool waters along the southern Brazilian coast. The Santa Catarina state is represented in light blue (SC). The green ellipse represents the southernmost limit of distribution for tropical reef fish. The dashed arc represents the "Arc of Capricorn" region.The dashed and green polygons and numbers represent most sampled areas.

1987). Only localized (Hostim-Silva et al. 2006) and small-scale initiatives have adressed this issue through the last decade (Barneche et al. 2009; Anderson et al. 2014a). In order to fill this knowledge gap, we provide an updated checklist of reef fishes for the state of Santa Catarina, including twelve new records. Some of these records are largely unexpected given they represent range extensions of many thousands of kilometers over regions where those species were unrecorded, despite the presense of suitable reef habitat.

MATERIALS AND METHODS

Study area

The coast of Santa Catarina is located between the latitudes 25°57′ S and 29°23′S, representing approximately 7% of the Brazilian coast (Diehl and Horn Filho 1996) (Figure 1). This region is influenced by continental inputs from rivers in the northern part of the coast (i.e., Itapucu, Itajaí-açu, Tijucas and Tubarão Rivers) (Carvalho et al. 1998; Hille et al. 2008). In the southern portion of the state, the upwelling phenomenon during austral summer and the influence of the La Plata River Plume (see PRSF Figure 1) and Sub-Antarctic Water (Subtropical Shelf Front) during austral winter are key oceanographic processes (Piola et al. 2000; Piola et al. 2005). Complex coastal geography, including numerous coastal islands, and the out put of various small to medium-sized rivers results in various types of environments, each having its own oceanographic features and species assemblages (Charrid 2011).

Data

We base this work on over 12 years of underwater observations using free and scuba diving conducted by the authors (Anderson et al. 2014a; and Marine Macroecology and Biogeography Laboratory photographic data bank), as well as museum vouchers and literature records (i.e., Godoy 1987; Carvalho-Filho 1999; Floeter et al. 2008; Hostim-Silva et al. 2006; Anderson et al. 2014a).

In this paper, we consider reef fish to be those species which are associated with hard substrates after their post-settlement stage, whose habitat includes the continental shelf and islands near the shore, and spend any part of their lifecycle associated with rocky reef systems, including occasional epipelagic and soft substrate species known to occasionally feed, shelter, reproduce or search for cleaning services in rock reefs. Species that have never been observed in reefs in the study region were not considered. This includes species from the families Achiridae, Atherinopsidae, Coryphaenydae, Cynoglossidae, Engraulidae, and some genera of Clupeidae and Scombridae. We consider here species that occur between the surface and depths to 50 m, acknowledging that, albeit deeper occuring species do indeed use reef habitat, we have not been able to adequately sample these depths.

Because of recent changes in the classification of fishes (e.g., Near et al. 2012; Faircloth et al. 2013), fish families are listed alphabetically. We adopted recent taxonomic changes in our classification: Westneat

and Alfaro (2005); Craig and Hastings (2007); Smith and Craig (2007); Choat et al. (2012); Boehm et al. (2013); Frable et al. (2013); Knudsen and Clements (2013); and Silveira et al. (2014).

We also included the following information regarding species biology:

Habitat distribution. The physionomy within a rocky reef where a species is usually recorded. We stipulated four different habitat types (Figure 2). The Reef slope (RS) is the zone associated with the presence of rocky substrate ranging from the surface to the point where sediments start to make up a substantial contribution to bottom cover. This reef zone ranges from vertical to gently sloping surfaces and comprise depths varying from six to almost 30 m. The Sandy bottom (SB) is the zone covered essencially by sandy sediments (although silt and clay might also occur in extremely sheltered reefs) adjacent to the rocky reef slope. Carbonate is a minor contributor to these sediments except for a few rhodolith banks that occur in this region. Albeit this could be considered a different zone, fishes that occur in this zone are often the same that occur in sand sediments. Very sparsely scattered granitic boulders also occur in this zone. The Interface (INT) is the transitional zone between the complex rocky reef and the sandy bottom, characterized by hard structures, including some holes, surrounded by a matrix of sand. Water Column (WC) is represented by the pelagic environment adjacent to the rocky reef (adapted from Luiz et al. 2008).

Abundance indicator. Based on a diver's likelihood of recording a species in its usual habitat and depth range on any given dive (adapted from Feitoza et al. 2003; Luiz et al. 2008; Humann and DeLoach 2014), where CO = common (sightings are frequent); OC = occasional (sightings are not expected on a regular basis); UN = unusual (sightings occur less than occasionally); and RA = rare (sightings are exceptional).

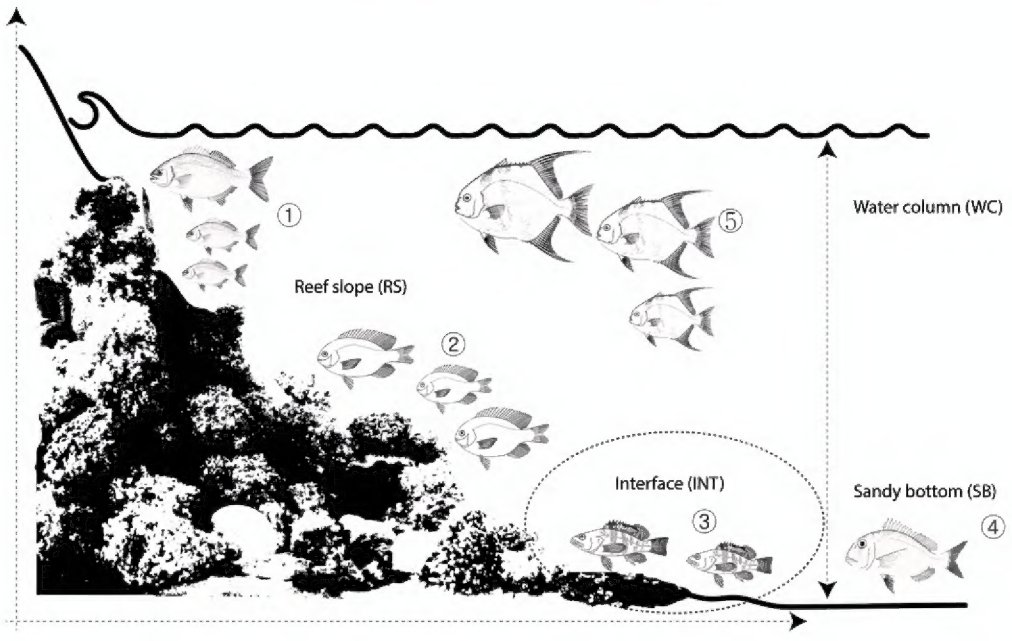

Figure 2. Hypothetical Santa Catarina rocky reef with examples of reef fish species typically associated with different zones. The Reef slope (RS) is associated to hard substrate, the Sandy bottom (SB) to sediments, the Interface (INT) is a transitional zone between the RS and the SB; and the Water column (WC) is absent on substrate. Examples of species commonly associated with a specific zone: (1) *Kyphosus vaigiensis* and (2) *Stegastes fuscus* (RS); (3) *Serranus flaviventris* (INT); (4) *Calamus penna* (SB) and (5) *Chaetodipterus faber* (WC).

Geographic range. The ranges of occurrence for species were based primarily in Floeter et al. (2008) and Carvalho-Filho (1999), with additional notes provided by Galván et al. (2009). Abbreviations are as follow CT = Circumtropical; CG = Circumglobal; AO = Atlantic Ocean; TA = Tropical Atlantic; EA = Eastern Atlantic; WA = Western Atlantic; SWA = Southwestern Atlantic; NWA = Northwestern Atlantic; MAR = Mid-Atlantic Ridge; MED = Mediterranean Sea; WIO = Western Indian Ocean; IP = Indo-Pacific Ocean; NWP = Northwestern Pacific; and TEP = Tropical Eastern Pacific (Froese and Pauly 2014). Brazilian Province endemics include species recorded from the southern tip of the Caribbean (Venezuela, Trinidad and Tobago and other islands of the Lesser Antilles), Cape Verde Archipelago and Ascension Island (Freitas et al. 2014), but which have 90% or more of its range in Brazil.

Trophic category. The diet of a species was based both in the literature (Randall 1967, 1996; Carvalho-Filho 1999; Ferreira et al. 2004; Luiz et al. 2008) and indirect observations performed by the authors, where MCAR = Macrocarnivores (species which feed mainly on mobile organisms, such as macroinvertebrates and fishes); MINV = Mobile Invertebrate Feeders (species which feed primarily on benthic mobile invertebrates, such as mollusks, crustaceans, and worms associated with hard or nearby unconsolidated substrate); OMNI = Omnivores (species which feed on a variety of resources, but that necessary include invertebrates and algae); PLANK = Planktivores (species which feed primarily on macro- and microplankton); HERB = Herbivores/Detritivores (species, both nonterritorial and territorial herbivores, which include in their diet detritus and macroalgae) and SINV = Sessile Invertebrate Feeders (species which feed on sessile benthic invertebrates, such as cnidarians, bryozoans, ascidians and sponges).

Record type. The method by which species were recorded and documented: VOU = Museum Vouchers (the institutions and voucher numbers of specimens are provided in Appendix 1); LIT = Literature; PHO = Photographs and SIG = Sighting during underwater fieldwork.

Multivariate analysis. To describe associations of fish families to trophic categories and habitat distribution we employed a Correspondence Analysis (Nenadic and Greenacre 2007) based on species richness (i.e., number of species per family). To avoid distortions caused by highly over-dispersed data, a "Hellinger" transformation was applied before proceeding with statistical analysis (Greenacre 2007).

RESULTS AND DISCUSSION

A total of 278 reef fish species in 170 genera and 74 families have been recorded along the coast of Santa Catarina during the past 12 years of underwater observations, as well as from the literature and museum vouchers (Table 1, Figure 3).

Based on species richness, the most representative families were Carangidae (20 species), Labridae (19 species), Carcharhinidae (11 species) and Epinephelidae (10 species). The most species-rich genera were *Carcharhinus* (eight species), followed by *Sphoeroides* and *Sparisoma* (five species). A total of 73 species were considered as "common" (CO = 26.3%), 69 species were considered "occasional" (OC = 24.8%), 132 species were considered "rare" (RA = 47.5%) (Figure 4), and four species were considered "unusual" (UN = 1.4%).

Some species are considered as "resident" organisms in the rocky reef systems, which means that they are dependent on the rocky reefs to complete their life cycles (62.6% or 174 species). All the others spend only part of their lives inhabiting the rocky reefs or adjacent habitats, and are able to survive using other habitats.

Trophic Structure

The two dominant trophic groups in this coastal region were the mobile invertebrate feeders (38.8%) and the macrocarnivores (32.4%), followed by planktivores (8.6%), omnivores (8.3%), herbivores/detritivores (7.6%) and sessile invertebrate feeders (4.3%) (Figure 5).

The high proportion of the mobile invertebrate feeders is a characteristic of reef fish assemblages worldwide (Ferreira et al. 2004; Luiz et al. 2008). The predators herein referred to as macrocarnivores include mainly Carcharhinidae (sharks), Carangidae (jacks and pompanos), Epinephelidae (groupers), Lutjanidae (snappers) and Scombridae (tunas and mackerels). In Santa Catarina, most planktivore species are Clupeidae and of the genus *Chromis* (Pomacentridae), as well as few species from other families. The herbivore/detritivores are mainly represented by Pomacentridae and Labridae-Scarini species. The sessile invertebrate feeders in this rocky environment are the generalists Chaetodontidae and Pomacanthidae, which consume a considerable amount of cnidarians and sponges, respectively. These families are also known to rely heavily on mobile invertebrates and algae, respectively.

Habitat distribution and threatened species

Distributions of rocky reef species within the habitat types, as evidenced herein by the Correspondence Analysis, mirror the classic ecological partitioning by fishes of the Brazilian rocky reef habitats (Sazima 1986). Specifically, apex predators, such as sharks, mesocarnivores, such as Carangidae and Scombridae, as well as Clupeidae and Engraulidae planktivores, all occupy the water column strata. Herbivores/detritivores, omnivores, mobile invertebrate feeders and Epinephelidae mesocarnivores occupy the reef slope, while mullets and flat fishes dwell on the sandy bottom (Sazima 1986, Figure 6).

Several species are considered threatened according to the IUCN endangered species Red List (IUCN 2015). The relative proportion of threatened species has reached 8.3% (or 23 of 278 species) and encompasses mostly top predators, such as sharks (34.8%) and groupers (17.4%).

Taxonomic updates

Following recent revisions of the families Kyphosidae (Knudsen and Clements 2013), Scaridae (Westneat and Alfaro 2005; Choat et al. 2012) and Serranidae (Craig and Hastings 2007; Smith and Craig 2007), and the genera *Hippocampus* (Boehm et al. 2013) and *Synodus* (Frable et al. 2013), some taxonomic updates shall be discussed. The whole family Scaridae is now recognized as a lineage of Labridae and now represents the Tribe Scarini (Westneat and Alfaro 2005; Choat et al. 2012). The family Epinephelidae was split from Serranidae, and the snowy grouper complex *Epinephelus niveatus* is now included in the previously invalidated genus *Hyporthodus* (i.e., *Hyporthodus niveatus*).

In the family Kyphosidae, the former species *Kyphosus incisor* (Cuvier, 1831), listed from Santa Catarina along with *Kyphosus sectatrix* (Linnaeus, 1758), both by Carvalho-Filho (1999) and Hostim-Silvaet al. (2006), is now revalidated as *Kyphosus vaigiensis* (Quoy & Gaimard, 1825) (Knudsen and Clements 2013). As this revision is recent, we could not determine wether the other Atlantic species, *K. cinerascens* and *K. bigibbus* do occur in Santa Catarina. In the genus *Hippocampus*, the Southwestern Atlantic species of the *H. erectus* complex is now considered to harbor two species, being *H. erectus* restricted to Brazil (Silveira et al. 2014), and the other ranging from Brazil to Uruguay and Argentina under the name of *Hippocampus patagonicus* Piacentino & Luzzatto, 2004 (Boehm et al. 2013; Silveira et al. 2014). In the *Synodus* genus, *Synodus foetens* (Linnaeus, 1766) may be considered restricted to nortwestern Atlantic (Frable et al. 2013). The species recorded for the southern part of Caribbean is now renamed as *Synodus bondi* Fowler, 1939. Although the authors suggest that the species which occur along Brazilian coast should be *S. bondi* (and we therefore consider it to), they did not possess a sufficient sampling of Brazilian individuals to avert the possibility that it is yet another species.

New Records and extreme range extensions

During this work, twelve species of reef fish were recorded for the first time for the coast of Santa Catarina: *Acanthurus coeruleus* (Bloch & Schneider, 1801); *Acanthurus monroviae* Steindachner, 1876; *Apogon*

Table 1. Checklist of reef fish species recorded at Santa Catarina State, Southern Brazil. The genera and species are separate in Chondrichthyes and Actinopterygii arranged in alphabetical order within families. **IUCN Status: CR** = Critically Endangered (extremely high risk of extinction in the wild); **EN** = Endangered (high risk of extinction in the wild);**VU** = Vulnerable (high risk of endangerment in the wild); **NT** = Near Threatened (likely to become endangered in the near future); **LC** = Least Concern (Lowest risk); **DD** = Data Deficient (not enough data to make an assessment of its risk of extinction); **NE** = Not Evaluated (not yet evaluated). **Trophic Category: MCAR** = Carnivore; **MINV** = Mobile Invertebrate Feeder; **SINV** = Sessile Invertebrate Feeder; **OMNI** = Omnivore; **PLANK** = Planktivore; **HERB** = Herbivore/Detritivore. **Habitat: RS** = Reef Slope; **INT =** Interface; **SB =** Sandy Bottom; **WC** = Water Column. **Residence (RE): R** = Reef associated. **Occurrence: CO** = Common; **OC** = Occasional; **UN** = Unusual; **RA** = Rare. **Geographic range: CT** = Circumtropical; **CG** = Circumglobal; **AO** = Atlantic Ocean; **TA** = Tropical Atlantic; **EA** = Eastern Atlantic; **WA** = Western Atlantic; **SWA** = Southwestern Atlantic; **NWA** = Northwestern Atlantic; **MAR** = Mid-Atlantic Ridge; **MED** = Mediterranean Sea; **WIO** = Western Indian Ocean; **IP** = Indo-Pacific Ocean; **NWP** = Northwestern Pacific; **TEP** = Tropical Eastern Pacific. **Record Type: LIT** = *in litteris*; **VOU** = Museum Voucher; **PHO** = Photograph; **SIG** = Underwater sighting. ***** = New record; **+** = Brazilian endemic species, including species recorded in southern tip of the Caribbean, Cape Verde Archipelago and Ascension Island (see Freitas et al. 2014).

Family	Species	Authority	IUCN	Trophic	Habitat	RE	Occur.	Geog. range	Rec.Type
Carcharhinidae	*Carcharhinus brevipinna*	(Müller & Henle, 1839)	NT	MCAR	WC		RA	WA/EA/MED/IP	VOU
	Carcharhinus isodon	(Müller & Henle, 1839)	LC	MCAR	WC		OC	WA	VOU
	Carcharhinus leucas	(Muller & Henle, 1839)	NT	MCAR	WC		RA	CT	LIT
	Carcharhinus limbatus	(Muller & Henle, 1839)	NT	MCAR	WC		RA	CT	LIT
	Carcharhinus obscurus	(LeSueur, 1818)	VU	MCAR	WC		RA	WA/EA/MED/IP	VOU
	Carcharhinus plumbeus	(Nardo, 1827)	VU	MCAR	WC		RA	CT	LIT/VOU
	Carcharhinus porosus	(Ranzani, 1839)	DD	MCAR	WC		RA	WA	VOU
	Carcharhinus signatus	(Poey, 1868)	VU	MCAR	WC		RA	WA/EA	VOU
	Galeocerdo cuvier	(Perón &LeSueur,1822)	NT	MCAR	WC		RA	CT	LIT
	Rhizoprionodon lalandii	(Müller & Henle, 1839)	DD	MCAR	WC		RA	WA	VOU
	Rhizoprionodon porosus	(Poey, 1861)	LC	MCAR	WC		RA	WA	LIT
Dasyatidae	*Dasyatis americana*	Hildebrand & Schroeder, 1928	DD	MINV	SB	R	RA	WA	LIT
	Dasyatis centroura	(Mitchill, 1815)	LC	MINV	SB		RA	WA/EA	SIG/LIT/PHO[3]
	Dasyatis guttata	(Bloch & Schneider, 1801)	DD	MINV	SB		RA	WA	SIG/LIT/PHO[1,3]
	Dasyatis hypostigma	Santos & Carvalho, 2004	LC	MINV	SB		RA	SWA	VOU
	Pteroplatytrygon violacea	(Bonaparte, 1832)	LC	MINV	SB		RA	CG	SIG/LIT/PHO[3]
Gymnuridae	*Gymnura altavela*	(Linnaeus, 1758)	VU	MINV	SB	R	RA	WA/EA	SIG/LIT/PHO[1]
Lamnidae	*Isurus oxyrhincus*	Rafinesque, 1810	VU	MCAR	WC		RA	CG	LIT
Myliobatidae	*Aetobatus narinari*	(Euphrasen, 1790)	NT	MINV	WC	R	RA	CT	SIG/LIT/PHO[1,2,3]
	Manta birostris	(Walbaum, 1792)	NT	PLANK	WC		UN	CG	LIT
	Mobula thurstoni	(Lloyd, 1908)	NT	PLANK	WC		UN	CG	LIT
Narcinidae	*Narcine brasiliensis*	(Olfers, 1831)	DD	MINV	SB	R	OC	WA	SIG/LIT/VOU/PHO[1,2,3]
Odontaspididae	*Carcharias taurus*	Rafinesque, 1810	VU	MCAR	WC/RS		RA	CG	LIT/PHO[4]
Rhinobatidae	*Rhinobatos horkelii*	Muller & Henle, 1841	CR	MINV	SB		RA	SWA	SIG/LIT/PHO[3]
	Rhinobatos percellens	(Walbaum, 1792)	NT	MINV	SB		RA	SWA/EA	LIT/VOU/PHO[3]
	Zapteryx brevirostris	(Muller & Henle, 1841)	VU	MINV	SB	R	RA	SWA	LIT/VOU
Rhincodontidae	*Rhincodon typus*	Smith, 1828	VU	PLANK	WC		RA	CT	LIT/PHO
Sphyrnidae	*Sphyrna lewini*	(Griffith & Smith, 1834)	EN	MCAR	WC		RA	CG	LIT/VOU
	Sphyrna tiburo	(Linnaeus, 1758)	LC	MCAR	WC		RA	WA/TEP	LIT
	Sphyrna zygaena	(Linnaeus, 1758)	VU	MCAR	WC		RA	CG	VOU
Acanthuridae	*Acanthurus bahianus+*	Castelnau, 1855	LC	HERB	RS/INT/SB	R	OC	SWA/MAR	SIG/LIT/VOU/PHO[1,2,3]
	Acanthurus chirurgus	(Bloch, 1787)	LC	HERB	RS/INT/SB	R	OC	AO	SIG/LIT/VOU/PHO[1,2,3]
	*Acanthurus coeruleus**	Bloch & Schneider, 1801	LC	HERB	RS/INT/SB	R	RA	WA/MAR	SIG/LIT/PHO[1,3]
	*Acanthurus monroviae**	Steindachner, 1876	LC	PLANK	WC/RS/INT		RA	EA	PHO[3]

Continued

Table 1. *Continued.*

Family	Species	Authority	IUCN	Trophic	Habitat	RE	Occur.	Geog. range	Rec.Type
Apogonidae	*Apogon americanus*+*	Castelnau, 1855	NE	PLANK	RS	R	OC	SWA	PHO[3]
	Apogon pseudomaculatus	Longley, 1932	NE	PLANK	RS	R	OC	WA/EA	SIG/LIT/PHO[1,2,3]
	Phaeoptyx pigmentaria	(Poey, 1860)	LC	PLANK	RS	R	OC	WA/EA	SIG/LIT/PHO[1,2,3]
Antennariidae	*Antennarius striatus*	(Shaw, 1794)	NE	MCAR	RS/INT	R	RA	CT	LIT
	Histrio histrio	(Linnaeus, 1758)	NE	MCAR	RS/INT		RA	CT	LIT
Ariidae	*Cathorops spixii*	(Agassiz, 1829)	NE	MCAR	SB		OC	WA	VOU
	Genidens barbus	(Lacepède, 1803)	NE	MCAR	SB		OC	SWA	VOU
	Genidens genidens	(Cuvier, 1829)	LC	MCAR	RS/INT/SB		RA	SWA	SIG/LIT/VOU/PHO[1,3]
Balistidae	*Balistes capriscus*	Gmelin, 1789	NE	MINV	RS/INT/SB	R	OC	WA/EA/MED	SIG/LIT/VOU
	Balistes vetula	Linnaeus, 1758	VU	MINV	RS/INT/SB	R	RA	AO	SIG/LIT/PHO[1,3]
Batrachoididae	*Porichthys porosissimus*	(Cuvier, 1829)	NE	MCAR	RS/INT/SB	R	CO	SWA	SIG/LIT/VOU/PHO[2,3]
	Thalassophryne montevidensis	(Berg, 1893)	NE	MCAR	SB/INT		RA	SWA	LIT
Belonidae	*Strongylura marina*	(Walbaum, 1792)	NE	OMNI	WC		OC	WA	VOU
	Tylosurus acus	(Lacepède, 1803)	NE	MCAR	WC		RA	CT	LIT
Blenniidae	*Hypleurochilus fissicornis*	(Quoy & Gaimard, 1824)	NE	MINV	RS/INT	R	CO	SWA/EA	SIG/LIT/VOU/PHO[1,3]
	Hypleurochilus pseudoaequipinnis	Bath, 1994	NE	MINV	RS/INT	R	OC	WA	LIT/VOU
	Hypsoblennius invemar	Smith-Vaniz & Acero, 1980	NE	MINV	RS	R	CO	WA	SIG/LIT/VOU
	Ophioblennius trinitatis+*	Miranda-Ribeiro, 1919	NE	HERB	RS	R	CO	SWA	SIG/LIT/VOU/PHO[1,3]
	Parablennius marmoreus	(Poey, 1876)	NE	OMNI	RS/INT	R	CO	WA	SIG/LIT/VOU
	Parablennius pilicornis	(Cuvier, 1829)	NE	OMNI	RS/INT	R	CO	SWA/EA/MED/WIO	SIG/LIT/VOU
	Scartella cristata	(Linnaeus, 1758)	NE	HERB	RS	R	CO	WA/EA/NWP	SIG/LIT/VOU/PHO[2,3]
Bothidae	*Bothus ocellatus*	(Agassiz, 1831)	NE	MINV	SB	R	OC	WA	SIG/LIT/VOU
	Bothus maculiferus	(Poey, 1860)	NE	MINV	SB		OC	WA/EA	SIG/LIT/PHO[3]
Callionymidae	*Callionymus bairdi*	Jordan, 1888	NE	MINV	RS/INT/SB	R	RA	AO	LIT/VOU/PHO[3]
Carangidae	*Alectis ciliaris*	(Bloch, 1787)	LC	MCAR	WC		RA	CT	SIG/LIT/PHO[3]
	Caranx crysos	(Mitchill, 1815)	LC	MCAR	WC	R	OC	AO	SIG/LIT/VOU/PHO[3]
	Caranx hippos	(Linnaeus, 1766)	NE	MCAR	WC	R	RA	WA/EA	SIG/LIT/VOU/PHO[3]
	Caranx latus	Agassiz, 1831	NE	MCAR	WC	R	RA	AO	SIG/LIT/VOU/PHO[1,3]
	Chloroscombrus chrysurus	(Linnaeus, 1766)	NE	PLANK	WC	R	RA	WA/EA	LIT/VOU
	Decapterus macarellus	(Cuvier, 1833)	NE	PLANK	WC		OC	CG	SIG/LIT/PHO[3]
	*Decapterus punctatus**	(Cuvier, 1829)	NE	PLANK	WC		OC	AO	SIG/PHO[3]
	Naucrates ductor	(Linnaeus, 1758)	NE	MCAR	WC		RA	CT	LIT
	Oligoplites saliens	(Bloch, 1793)	NE	PLANK	WC		RA	WA	SIG/LIT/VOU/PHO[3]
	Oligoplites saurus	(Bloch & Schneider, 1801)	NE	MCAR	WC		RA	WA/TEP	LIT/VOU
	Pseudocaranx dentex	(Bloch & Schneider, 1801)	NE	PLANK	WC/SB	R	CO	CT	SIG/LIT/VOU
	Selene setapinnis	(Mitchill, 1815)	NE	MCAR	WC		RA	WA	VOU
	Selene vomer	(Linnaeus, 1758)	NE	MCAR	WC		OC	WA	SIG/LIT/VOU/PHO[3]
	Seriola dumerili	(Risso, 1810)	NE	MCAR	WC	R	OC	CG	SIG/LIT/PHO[1,2,3]
	Seriola lalandi	Valenciennes, 1833	NE	MCAR	WC	R	OC	CG	SIG/LIT/PHO[1,3]
	Seriola rivoliana	Valenciennes, 1833	NE	MCAR	WC	R	OC	CG	SIG/LIT/PHO[1,2,3]
	Trachinotus carolinus	(Linnaeus, 1766)	NE	MCAR	WC	R	OC	WA	SIG/LIT/VOU/PHO[3]
	Trachinotus falcatus	(Linnaeus, 1758)	NE	MCAR	WC	R	OC	WA	SIG/LIT/VOU/PHO[1,3]
	Trachinotus goodei	Jordan & Evermann, 1896	NE	MCAR	WC	R	OC	WA	SIG/LIT/PHO[1,3]

Continued

Table 1. *Continued.*

Family	Species	Authority	IUCN	Trophic	Habitat	RE	Occur.	Geog. range	Rec.Type
	Trachinotus marginatus	(Cuvier, 1832)	NE	MCAR	WC	R	CO	WA	SIG/LIT/VOU/PHO[3]
Centropomidae	*Centropomus undecimalis*	(Bloch, 1792)	NE	MCAR	RS/INT/SB	R	CO	WA	SIG/LIT/VOU
	Centropomus parallelus	Poey, 1860	NE	MCAR	RS/INT/SB	R	CO	WA	SIG/LIT/VOU/PHO[3]
Chaenopsidae	*Emblemariopsis signifer*	(Ginsburg, 1942)	LC	MINV	RS/INT	R	CO	WA	SIG/LIT/VOU
Chaetodontidae	*Chaetodon sedentarius**	Poey, 1860	LC	SINV	RS/INT/SB	R	RA	WA/EA	LIT/PHO[3]
	Chaetodon striatus	Linnaeus, 1758	LC	SINV	RS/INT/SB	R	CO	WA	SIG/LIT/VOU
	Prognathodes guyanensis	(Durand, 1960)	LC	SINV	RS/INT/SB	R	RA	WA	LIT/VOU
Cirrhitidae	*Amblycirrhitus pinos*	(Mowbray, 1927)	NE	MINV	RS/INT	R	RA	WA/MAR	LIT/PHO[1,2,3]
Clupeidae	*Harengula clupeola*	(Cuvier, 1829)	NE	PLANK	WC		CO	WA	VOU/PHO[1,3]
	Opisthonema oglinum	(LeSueur, 1818)	NE	PLANK	WC		RA	WA	LIT/VOU
	Sardinella aurita	Valenciennes, 1847	NE	PLANK	WC		RA	WA/EA	LIT
	Sardinella brasiliensis	(Steindachner, 1879)	NE	PLANK	WC		CO	WA	SIG/LIT/VOU/PHO[3]
Dactylopteridae	*Dactylopterus volitans*	(Linnaeus, 1758)	NE	MINV	INT/SB	R	OC	WA/EA	SIG/LIT/VOU
Dactyloscopidae	*Dactyloscopus crossotus*	Starks, 1913	NE	MINV	INT/SB		RA	WA	LIT/VOU
	Dactyloscopus foraminosus	Dawson, 1982	LC	MINV	INT/SB		RA	WA	LIT
	Dactyloscopus tridigitatus	Gill, 1859	LC	MINV	INT/SB		RA	WA	LIT
Diodontidae	*Chilomycterus reticulatus*	(Linnaeus, 1758)	NE	SINV	RS/INT/SB	R	RA	CG	SIG/LIT/VOU/PHO
	Chilomycterus spinosus	(Linnaeus, 1758)	NE	SINV	RS/INT/SB	R	OC	SWA	SIG/LIT/VOU/PHO[1,3]
	Diodon holocanthus	Linnaeus, 1758	NE	SINV	RS/INT/SB	R	OC	CT	SIG/LIT/PHO[3]
	Diodon hystrix	Linnaeus, 1758	NE	SINV	RS/INT/SB	R	OC	CT	SIG/LIT/PHO[1,3]
Echeneidae	*Echeneis naucrates*	Linnaeus, 1758	NE	MCAR	WC		RA	CT	LIT/VOU/PHO[2,3]
	Remora remora	(Linnaeus, 1758)	NE	MCAR	WC		RA	CT	LIT
Eleotridae	*Eleotris pisonis*	(Gmelin, 1789)	NE	MINV	RS/INT		RA	WA	LIT/VOU
Ephippidae	*Chaetodipterus faber*	(Broussonet, 1782)	NE	MINV	WC	R	CO	WA	SIG/LIT/VOU
Epinephelidae	*Epinephelus adscensionis*	(Osbeck, 1765)	LC	MCAR	RS/INT/SB	R	RA	AO	SIG/LIT
	Epinephelus itajara	(Lichtenstein, 1822)	CR	MCAR	RS/INT/SB	R	RA	WA/EA	LIT/PHO[1,2,3]
	Epinephelus marginatus	(Lowe, 1834)	EN	MCAR	RS/INT/SB	R	CO	WA/EA	SIG/LIT/VOU
	Epinephelus morio	(Valenciennes, 1828)	NT	MCAR	RS/INT/SB	R	OC	WA	SIG/LIT/PHO[1,3]
	Hyporthodus niveatus	(Valenciennes, 1828)	VU	MCAR	RS/INT/SB	R	CO	WA	SIG/LIT/VOU
	Mycteroperca acutirostris	(Valenciennes, 1828)	LC	MCAR	RS/INT/SB	R	CO	WA	SIG/LIT/VOU/PHO[1,2,3]
	Mycteroperca bonaci	(Poey, 1860)	NT	MCAR	RS/INT/SB	R	OC	WA	SIG/LIT/VOU/PHO[1,2,3]
	Mycteroperca interstitialis	(Poey, 1860)	VU	MCAR	RS/INT/SB	R	RA	WA	SIG/LIT/PHO[1,3]
	Mycteroperca microlepis	(Goode & Bean, 1879)	LC	MCAR	RS/INT/SB	R	RA	WA	SIG/LIT/PHO[3]
	Paranthias furcifer	(Valenciennes, 1828)	LC	PLANK	INT/SB	R	RA	WA/EA	SIG/LIT/PHO[1,3]
Fistulariidae	*Fistularia petimba*	Lacepède, 1803	NE	MCAR	RS/INT/SB	R	RA	WA/EA/MED/IP	VOU
	Fistularia tabacaria	Linnaeus, 1758	NE	MCAR	RS/INT/SB	R	CO	WA/EA	SIG/LIT/VOU/PHO[1,3]
Gerreidae	*Diapterus auratus*	Ranzani, 1842	NE	MINV	INT/SB		CO	WA	SIG/LIT/VOU/PHO[3]
	Diapterus rhombeus	(Cuvier, 1829)	NE	MINV	INT/SB		OC	WA	VOU
	Eucinostomus argenteus	Baird & Girard, 1855	NE	MINV	INT/SB		OC	EP/WA/EA	VOU
	Eucinostomus gula	(Quoy & Gaimard, 1824)	NE	MINV	INT/SB		CO	WA	SIG/LIT/VOU/PHO[3]
	Eucinostomus melanopterus	(Bleeker, 1863)	NE	MINV	INT/SB		CO	WA/EA	SIG/LIT/VOU/PHO[3]
	Eugerres brasilianus	(Cuvier, 1830)	NE	MINV	INT/SB		CO	WA	SIG/LIT/VOU/PHO[3]
Gobiesocidae	*Gobiesox barbatulus*	Starks, 1913	NE	MINV	RS		RA	WA	SIG/LIT/VOU/PHO[3]

Continued

Table 1. *Continued.*

Family	Species	Authority	IUCN	Trophic	Habitat	RE	Occur.	Geog. range	Rec.Type
	Tomicodon australis	Briggs 1955	NE	MINV	RS		RA	WA	VOU
Gobiidae	*Barbulifer ceuthoecus*	(Jordan & Gilbert, 1884)	NE	MINV	INT/SB		RA	WA	LIT/VOU
	Bathygobius soporator	(Valenciennes, 1837)	NE	MINV	RS/INT/SB		CO	EA/WA/MED	SIG/LIT/VOU/PHO[3]
	Coryphopterus glaucofraenum	Gill, 1863	NE	OMNI	INT/SB	R	CO	WA	SIG/LIT/VOU
	Ctenogobius saepepallens	(Gilbert & Randall, 1968)	NE	MINV	INT/SB		RA	WA	SIG/LIT/PHO[1,3]
	Ctenogobius stigmaticus	(Poey, 1860)	NE	MINV	RS/INT/SB		RA	WA	LIT/VOU
	Elacatinus figaro+	Sazima, Moura & Rosa, 1996	NE	MINV	RS/INT/SB	R	RA	SWA	LIT/VOU
	Gnatholepis thompsoni	Jordan, 1904	NE	MINV	RS/INT/SB	R	RA	WA	SIG/LIT
	Gobiosoma hemigymnum	(Eingenmann & Eingenmann, 1888)	NE	MINV	RS/INT/SB		RA	WA	LIT/PHO[3]
	Microgobius meeki	Evermann & Marsh, 1899	NE	MINV	RS/INT/SB		RA	WA	LIT/VOU
Haemulidae	*Anisotremus surinamensis*	(Bloch, 1791)	NE	MINV	RS/INT	R	CO	WA	SIG/LIT/VOU
	Anisotremus virginicus	(Linnaeus, 1758)	NE	MINV	RS/INT	R	CO	WA	SIG/LIT/VOU
	Haemulon aurolineatum	Cuvier, 1830	NE	MINV	RS/INT/SB	R	CO	WA	SIG/LIT/VOU
	Haemulon steindachneri	(Jordan & Gilbert, 1882)	NE	MINV	RS/INT/SB	R	OC	WA	SIG/LIT/VOU/PHO[3]
	Haemulon parra	(Desmarest, 1823)	NE	MINV	RS/INT/SB	R	OC	WA	SIG/LIT/PHO[3]
	Orthopristis ruber	(Cuvier, 1830)	NE	MINV	RS/INT/SB	R	CO	WA	SIG/LIT/VOU
Hemiramphidae	*Hemiramphus brasiliensis*	(Linnaeus, 1758)	NE	OMNI	WC		OC	WA/EA	SIG/LIT/VOU/PHO[3]
	Hyporhamphus unifasciatus	(Ranzani, 1841)	NE	OMNI	WC		RA	WA	SIG/LIT/VOU/PHO[3]
Holocentridae	*Holocentrus adscensionis*	(Osbeck, 1765)	NE	MINV	RS/INT/SB	R	CO	AO	SIG/LIT/VOU
	Myripristis jacobus	Cuvier, 1829	NE	MINV	RS/INT	R	RA	AO	SIG/LIT/VOU
Kyphosidae	*Kyphosus sectatrix*	(Linnaeus, 1758)	NE	HERB	RS	R	CO	CT	SIG/LIT/PHO[3]
	Kyphosus vaigiensis	(Quoy & Gaimard, 1825)	NE	HERB	RS	R	CO	CT	SIG/LIT/VOU
Labridae - Hypsigeninae	*Bodianus pulchellus*	(Poey, 1860)	LC	MINV	RS/INT	R	OC	WA/EA	SIG/LIT/VOU
	Bodianus rufus	(Linnaeus, 1758)	LC	MINV	RS/INT	R	CO	WA	SIG/LIT/PHO[1,2,3]
	*Clepticus brasiliensis**+	Heiser, Moura & Robertson, 2000	LC	PLANK	RS/WC	R	RA	SWA	SIG/LIT/PHO[1,3]
Labridae - Julidinae	*Doratonotus megalepis*	Günther 1862	LC	MINV	RS	R	RA	WA	SIG/LIT
	Halichoeres brasiliensis+	(Bloch, 1791)	LC	MINV	RS/INT/SB	R	OC	SWA	SIG/LIT/PHO[1,3]
	Halichoeres dimidiatus	(Agassiz, 1831)	LC	MINV	RS/INT/SB	R	RA	SWA	SIG/LIT/PHO[3]
	Halichoeres poeyi	(Steindachner, 1867)	LC	MINV	RS/INT/SB	R	CO	WA	SIG/LIT/VOU
	Halichoeres sazimai+	Luiz, Ferreira & Rocha, 2009	NE	MINV	RS/INT/SB	R	RA	SWA	SIG/LIT/PHO[3]
	Thalassoma noronhanum+	(Boulenger, 1890)	LC	PLANK	RS/INT/SB	R	RA	SWA	SIG/LIT/PHO[1,3]
	Xyrichtys novacula	(Linnaeus, 1758)	LC	MINV	SB	R	RA	WA/EA	SIG/LIT/VOU/PHO[1,3]
Labridae - Scarini	*Cryptotomus roseus*	Cope, 1871	LC	HERB	RS/INT/SB	R	CO	WA/MAR	SIG/LIT/VOU/PHO[1,2,3]
	Nicholsina usta	Valenciennes, 1840	LC	HERB	RS/INT	R	RA	WA	SIG/LIT/PHO[3]
	Scarus trispinosus+	Valenciennes, 1840	EN	HERB	RS/INT/SB	R	RA	SWA	LIT/PHO[1,3]
	Scarus zelindae+	Moura, Figueiredo & Sazima, 2001	DD	HERB	RS/INT/SB	R	RA	SWA	SIG/LIT/PHO[1,3]
	Sparisoma amplum+	(Ranzani, 1841)	LC	HERB	RS/INT/SB	R	CO	SWA	SIG/LIT/PHO[1,2,3]
	Sparisoma axillare+	(Steindachner, 1878)	LC	HERB	RS/INT/SB	R	CO	SWA	SIG/LIT/PHO[1,2,3]
	Sparisoma frondosum+	(Agassiz, 1831)	DD	HERB	RS/INT/SB	R	CO	SWA/EA	SIG/LIT/PHO[1,2,3]
	Sparisoma radians	(Valenciennes, 1840)	LC	HERB	RS/INT/SB	R	CO	SWA	SIG/LIT/PHO[1,3]
	Sparisoma tuiupiranga+	Gasparini, Joyeux & Floeter, 2003	LC	HERB	RS/INT/SB	R	OC	SWA	SIG/LIT/PHO[1,2,3]
Labrisomidae	*Labrisomus cricota*+	Sazima, Gasparini & Moura, 2002	NE	MINV	RS/INT	R	RA	SWA	SIG/LIT/VOU/PHO[3]

Continued

Table 1. *Continued.*

Family	Species	Authority	IUCN	Trophic	Habitat	RE	Occur.	Geog. range	Rec.Type
	Labrisomus nuchipinnis	(Quoy & Gaimard, 1824)	NE	MINV	RS/INT	R	CO	WA/EA	SIG/LIT/VOU
	Malacoctenus delalandii	(Valenciennes, 1836)	NE	MINV	RS/INT	R	CO	WA	SIG/LIT/PHO[1,2,3]
	Malacoctenus aff. triangulatus+		NE	MINV	RS/INT	R	RA	SWA	LIT/VOU
	Paraclinus rubicundus	(Starks, 1913)	LC	MINV	RS/INT	R	RA	SWA	LIT
	Paraclinus spectator+	Guimarães & Bacelar, 2002	NE	MINV	RS/INT	R	OC	SWA	SIG/LIT/PHO[1,3]
	Starksia brasiliensis+	(Gilbert, 1900)	NE	MINV	RS/INT	R	OC	SWA	SIG/LIT/VOU/PHO[3]
Lobotidae	*Lobotes surinamensis*	(Bloch, 1790)	NE	MCAR	RS/INT		RA	CT	LIT/PHO[3]
Lutjanidae	*Lutjanus analis*	(Cuvier, 1828)	VU	MCAR	RS/INT/SB	R	RA	WA	SIG/LIT/VOU/PHO[1,3]
	Lutjanus cyanopterus	(Cuvier, 1828)	VU	MCAR	RS/INT/SB	R	RA	WA	SIG/LIT/PHO[3]
	Lutjanus jocu	(Bloch & Schneider, 1801)	NE	MCAR	RS/INT/SB	R	RA	WA/MAR	SIG/LIT/VOU/PHO[1,3]
	Rhomboplites aurorubens	(Cuvier, 1829)	NE	MCAR	RS/INT	R	OC	WA	SIG/LIT/PHO[1,3]
Malacanthidae	*Malacanthus plumieri*	(Bloch, 1786)	NE	MCAR	RS/INT/SB	R	OC	WA/MAR	SIG/LIT/VOU/PHO[1,3]
Microdesmidae	*Ptereleotris randalli+*	Gasparini, Rocha & Floeter, 2001	NE	MINV	SB	R	OC	SWA	SIG/LIT/PHO[1,3]
Monacanthidae	*Aluterus monoceros*	(Linnaeus, 1758)	NE	OMNI	RS/INT/SB	R	OC	CT	SIG/LIT/PHO[1,2,3]
	Aluterus scriptus	(Osbeck, 1765)	NE	OMNI	RS/INT/SB	R	RA	CT	PHO/LIT
	*Cantherhines macrocerus**	(Hollard, 1853)	NE	SINV	RS	R	RA	WA/EA	PHO
	Monacanthus ciliatus	(Mitchill, 1818)	NE	OMNI	RS/INT/SB	R	RA	WA	LIT/VOU
	Stephanolepis hispidus	(Linnaeus, 1766)	NE	OMNI	RS/INT/SB	R	CO	WA/EA	SIG/LIT/VOU
	Stephanolepis setifer	(Bennett, 1831)	NE	OMNI	RS/INT/SB	R	RA	WA	LIT
Mugilidae	*Mugil curema*	Valenciennes, 1836	NE	OMNI	INT/SB	R	CO	WA/EA/TEP	SIG/LIT/VOU
	Mugil liza	Valenciennes, 1836	NE	OMNI	INT/SB		CO	WA	SIG/LIT/VOU/PHO[3]
Mullidae	*Pseudupeneus maculatus*	(Bloch, 1793)	NE	MINV	RS/INT/SB	R	CO	WA	SIG/LIT/VOU
	Upeneus parvus	Poey, 1852	NE	MINV	RS/INT/SB		RA	WA	LIT/PHO
Muraenidae	*Echidna catenata*	(Bloch, 1795)	NE	MCAR	RS	R	RA	WA/MAR	LIT/VOU
	Gymnothorax funebris	Ranzani, 1839	NE	MCAR	RS	R	OC	WA	SIG/LIT/PHO[1,2,3]
	Gymnothorax moringa	(Cuvier,1829)	NE	MCAR	RS	R	CO	WA/MAR	SIG/LIT/VOU
	Gymnothorax ocellatus	Agassiz, 1831	NE	MCAR	RS		RA	AO	VOU
	*Gymnothorax vicinus**	(Castelnau, 1855)	NE	MCAR	RS	R	OC	TA	PHO[3]
	*Muraena retifera**	Goode & Bean, 1882	NE	MCAR	INT/SB	R	RA	WA	PHO
Ogcocephalidae	*Ogcocephalus vespertilio*	(Linnaeus, 1758)	NE	MINV	RS/INT/SB	R	CO	WA	SIG/LIT/VOU
Ophichthidae	*Ahlia egmontis*	(Jordan, 1884)	NE	MINV	RS/INT/SB	R	RA	WA	LIT
	Myrichthys breviceps	(Richardson, 1848)	NE	MINV	RS/INT	R	OC	WA	SIG/LIT/VOU
	Myrichthys ocellatus	(LeSueur, 1825)	NE	MINV	RS/INT	R	CO	WA	SIG/LIT/VOU
	Myrophis punctatus	Lütken, 1852	NE	MINV	RS/INT/SB		RA	WA	LIT
	*Herpetoichthys regius**	(Richardson, 1848)	NE	MINV	INT/SB	R	UN	EA	SIG/PHO[3]
	Ophichthusophis	(Castelnau, 1855)	NE	MINV	INT/SB		RA	WA	PHO
Ophidiidae	*Genipterus brasiliensis*	Regan, 1903	NE	MINV	SB/INT		RA	SWA	LIT
	Ophidion holbrooki	Putnam, 1874	NE	MINV	SB/INT		RA	WA	LIT/VOU
	Raneya brasiliensis	(Kaup, 1856)	NE	MINV	SB/INT		RA	SWA	LIT
Ostraciidae	*Acanthostracion polygonius*	Poey, 1876	NE	OMNI	RS/INT/SB	R	OC	WA	SIG/LIT/PHO[1,2,3]
	Acanthostracion quadricornis	(Linnaeus, 1758)	NE	OMNI	RS/INT/SB	R	OC	WA/EA	SIG/LIT/VOU
	Lactophys trigonus	(Linnaeus, 1758)	NE	OMNI	RS/INT/SB		RA	WA	LIT/VOU
Paralichthyidae	*Cyclopsetta fimbriata*	(Goode & Bean, 1885)	NE	MINV	SB		OC	WA	SIG/LIT/PHO[3]

Continued

Table 1. *Continued.*

Family	Species	Authority	IUCN	Trophic	Habitat	RE	Occur.	Geog. range	Rec.Type
	Paralichthys brasiliensis	(Ranzani, 1842)	NE	MINV	SB		OC	SWA	LIT/VOU
	Syacium micrurum	Ranzani, 1842	NE	MINV	SB		RA	WA	VOU
	Syacium papillosum	(Linnaeus, 1758)	NE	MINV	SB		RA	WA/MAR	LIT
Pempheridae	*Pempheris schomburgki*	Müller & Troschel, 1848	NE	PLANK	RS/INT	R	CO	WA	SIG/LIT/VOU
Polynemidae	*Polydactylus oligodon*	(Günther, 1860)	NE	OMNI	INT/SB		RA	WA	LIT
	Polydactylus virginicus	(Linnaeus, 1758)	NE	OMNI	INT/SB		RA	WA	LIT/VOU
Pomacanthidae	*Centropyge aurantanotus*	Burgess, 1974	LC	HERB	RS/INT	R	RA	WA/EA	SIG/LIT/PHO[3]
	Holacanthus ciliaris	(Linnaeus, 1758)	LC	SINV	RS/INT/SB	R	RA	WA	SIG/LIT/VOU
	Holacanthus tricolor	(Bloch, 1795)	LC	SINV	RS/INT/SB	R	RA	WA	SIG/LIT/PHO[1,2,3]
	Pomacanthus arcuatus	(Linnaeus, 1758)	LC	SINV	RS/INT/SB	R	RA	WA	SIG/LIT/PHO[1,3]
	Pomacanthus paru	(Bloch, 1787)	LC	SINV	RS/INT/SB	R	CO	WA/MAR	SIG/LIT/VOU
Pomacentridae	*Abudefduf saxatilis*	(Linnaeus, 1758)	NE	OMNI	RS/INT/SB	R	CO	AO	SIG/LIT/VOU
	*Chromis flavicauda**	(Günther, 1880)	DD	PLANK	RS/INT	R	RA	WA/EA	SIG/LIT/PHO[3]
	Chromis jubauna+	Moura, 1995	NE	PLANK	RS/INT	R	RA	SWA	SIG/LIT/VOU/PHO[1,3]
	Chromis limbata	(Valenciennes, 1833)	NE	PLANK	RS/INT	R	CO	WA/EA	SIG/LIT/PHO[1,3]
	Chromis multilineata	(Guichenot, 1853)	NE	PLANK	RS/INT	R	CO	AO	SIG/LIT/VOU
	Stegastes fuscus+	(Cuvier, 1830)	LC	HERB	RS/INT	R	CO	SWA	SIG/LIT/VOU
	*Stegastes partitus**	(Poey, 1868)	NE	HERB	RS/INT	R	UN	NWA	SIG/PHO[3]
	Stegastes pictus+	(Castelnau, 1855)	NE	HERB	RS/INT	R	CO	SWA	SIG/LIT/VOU
	Stegastes variabilis	(Castelnau, 1855)	NE	HERB	RS/INT	R	CO	SWA	SIG/LIT/VOU
Pomatomidae	*Pomatomus saltatrix*	(Linnaeus, 1766)	NE	MCAR	WC	R	CO	CG	SIG/LIT/VOU
Priacanthidae	*Cookeolus japonicus*	(Cuvier, 1829)	NE	MINV	RS/INT	R	RA	CG	LIT/VOU
	Priacanthus arenatus	Cuvier, 1829	NE	MINV	RS/INT	R	OC	WA/EA	SIG/LIT/VOU/PHO[1,3]
Rachycentridae	*Rachycentron canadum*	(Linnaeus 1766)	NE	MCAR	RS/INT/SB		RA	CT	LIT/VOU
Sciaenidae	*Menticirrhus americanus*	(Linnaeus, 1758)	NE	MINV	INT/SB		CO	WA	LIT/VOU/PHO
	Menticirrhus littoralis	(Holbrook, 1847)	NE	MINV	INT/SB		OC	WA	VOU
	Micropogonias furnieri	(Desmarest, 1823)	NE	MINV	INT/SB		CO	WA	LIT/VOU/PHO
	Odontoscion dentex	(Cuvier, 1830)	NE	MCAR	RS/INT	R	CO	WA	SIG/LIT/VOU
	Pareques acuminatus	(Bloch & Schneider, 1801)	NE	MINV	RS/INT/SB	R	CO	WA	SIG/LIT/VOU
Scombridae	*Acanthocybium solandri*	(Cuvier, 1832)	LC	MCAR	WC		OC	CT	LIT
	Euthynnus alletteratus	(Rafinesque, 1810)	LC	MCAR	WC		OC	AO	LIT/PHO[3]
	Scomberomorus brasiliensis	Collette, Russo & Zavala-Camin, 1978	LC	MCAR	WC		OC	WA	LIT/VOU
	Scomberomorus cavalla	(Cuvier, 1829)	LC	MCAR	WC		OC	WA/EA	LIT
Scorpaenidae	*Scorpaena brasiliensis*	Cuvier, 1829	NE	MCAR	RS/INT/SB	R	OC	WA	SIG/LIT/PHO[1,3]
	Scorpaena isthmensis	Meek & Hildebrand, 1928	NE	MCAR	RS/INT/SB	R	OC	WA	VOU
	Scorpaena plumieri	Bloch, 1789	NE	MCAR	RS/INT/SB	R	OC	WA/MAR	SIG/LIT/VOU/PHO[1,3]
Serranidae	*Diplectrum formosum*	(Linnaeus, 1766)	NE	MCAR	SB	R	CO	WA	SIG/LIT/VOU/PHO[1,3]
	Diplectrum radiale	(Quoy & Gaimard, 1824)	NE	MCAR	SB	R	CO	WA	SIG/LIT/VOU/PHO[1,3]
	Dules auriga	Cuvier, 1829	NE	MCAR	INT/SB	R	CO	SWA	SIG/LIT/PHO[1,2,3]
	Rypticus randalli	Courtenay, 1967	NE	MCAR	RS/INT		RA	WA/EA	LIT/VOU
	Rypticus saponaceus	(Bloch & Schneider, 1801)	NE	MCAR	RS/INT	R	RA	AO	LIT
	Serranus atrobranchus	(Cuvier, 1829)	NE	MINV	INT/SB	R	CO	WA	SIG/LIT/PHO[1,2,3]
	Serranus baldwini	(Evermann & Marsch, 1899)	NE	MINV	INT/SB	R	CO	WA	SIG/LIT/PHO[1,2,3]

Continued

Table 1. *Continued.*

Family	Species	Authority	IUCN	Trophic	Habitat	RE	Occur.	Geog. range	Rec.Type
	Serranus flaviventris	(Cuvier, 1829)	NE	MINV	INT/SB	R	CO	WA	SIG/LIT/VOU
Sparidae	*Archosargus probatocephalus*	(Walbaum, 1792)	NE	MINV	RS/INT	R	OC	WA	LIT
	Archosargus rhomboidalis	(Linnaeus, 1758)	NE	OMNI	RS/INT/SB	R	RA	WA	SIG/LIT/VOU/PHO[3]
	Calamus penna	(Valenciennes, 1830)	NE	MINV	INT/SB	R	RA	WA	SIG/LIT/PHO[1,3]
	Calamus pennatula	Guichenot, 1868	NE	MINV	INT/SB	R	RA	WA	SIG/LIT/VOU/PHO[3]
	Diplodus argenteus	(Valenciennes, 1830)	NE	OMNI	RS/INT/SB	R	CO	SWA	SIG/LIT/VOU
	Pagrus pagrus	(Linnaeus, 1758)	EN	MCAR	RS/INT/SB		RA	WA	LIT/VOU
Sphyraenidae	*Sphyraena barracuda*	(Edwards, 1771)	NE	MCAR	RS/INT/SB	R	RA	CT	SIG/LIT/PHO[2,3]
	Sphyraena guachancho	Cuvier, 1829	NE	MCAR	RS/INT/SB	R	OC	WA/EA	SIG/LIT/VOU/PHO[3]
	Sphyraena tome	Fowler, 1903	NE	MCAR	RS/INT/SB	R	OC	SWA	VOU
Syngnathidae	*Halicampus crinitus*	(Jenyns, 1842)	NE	MINV	RS/INT	R	OC	WA	SIG/LIT/PHO[1,2,3]
	Hippocampus erectus	Perry, 1810	VU	MINV	RS/INT	R	OC	WA/MAR	SIG/LIT/VOU
	Hippocampus patagonicus	Piacentino & Luzzato, 2004	VU	MINV	RS/INT	R	OC	SWA	SIG/LIT/VOU/PHO[3]
	Hippocampus reidi	Ginsburg, 1933	VU	MINV	RS/INT	R	OC	WA	SIG/LIT/VOU
	Microphis lineatus	(Kaup, 1856)	NE	MINV	RS/INT		RA	WA	VOU
	Syngnathus folletti	Herald, 1942	NE	MINV	RS/INT		RA	SWA	VOU
Synodontidae	*Synodus intermedius*	(Spix & Agassiz, 1829)	NE	MCAR	RS/INT/SB	R	RA	WA	LIT/PHO[3]
	Synodus bondi	Fowler, 1939	NE	MCAR	INT/SB		RA	WA	LIT/VOU/PHO[3]
	Synodus synodus	(Linnaeus, 1758)	NE	MCAR	RS/INT/SB	R	CO	AO	SIG/LIT/PHO[1,2,3]
	Trachynocephalus myops	(Forster, 1801)	DD	MCAR	INT/SB		RA	AO	LIT
Tetraodontidae	*Canthigaster figueiredoi+*	Moura & Castro, 2002	NE	OMNI	RS/INT/SB	R	OC	WA	SIG/LIT/VOU
	Lagocephalus laevigatus	(Linnaeus, 1766)	NE	OMNI	SB		OC	WA/EA	LIT/VOU
	Sphoeroides greeleyi	Gilbert, 1900	NE	MINV	RS/INT/SB	R	CO	WA	VOU
	Sphoeroides pachygaster	(Müller & Troschel, 1848)	NE	MINV	RS/INT/SB		RA	CG	LIT
	Sphoeroides spengleri	(Bloch, 1785)	NE	MINV	RS/INT/SB	R	CO	WA/EA	SIG/LIT/VOU
	Sphoeroides testudineus	(Linnaeus, 1758)	NE	MINV	RS/INT/SB	R	CO	WA	SIG/LIT/VOU
	Sphoeroides tyleri	Shipp, 1972	NE	MINV	RS/INT/SB		RA	WA	LIT/VOU
Triglidae	*Prionotus nudigula*	Ginsburg, 1950	NE	MINV	INT/SB		RA	SWA	VOU
	Prionotus punctatus	(Bloch, 1793)	NE	MINV	INT/SB		RA	WA	LIT/VOU
Uranoscopidae	*Astroscopus y-graecum*	(Cuvier, 1829)	DD	MCAR	INT/SB		RA	WA	LIT/PHO[3]

Photographic records:
1. Anderson et al. 2014a
2. Hostim-Silva et al. 2006
3. Marine Macroecology and Biogeography Lab, Photographic Databank
4. Souza 2000

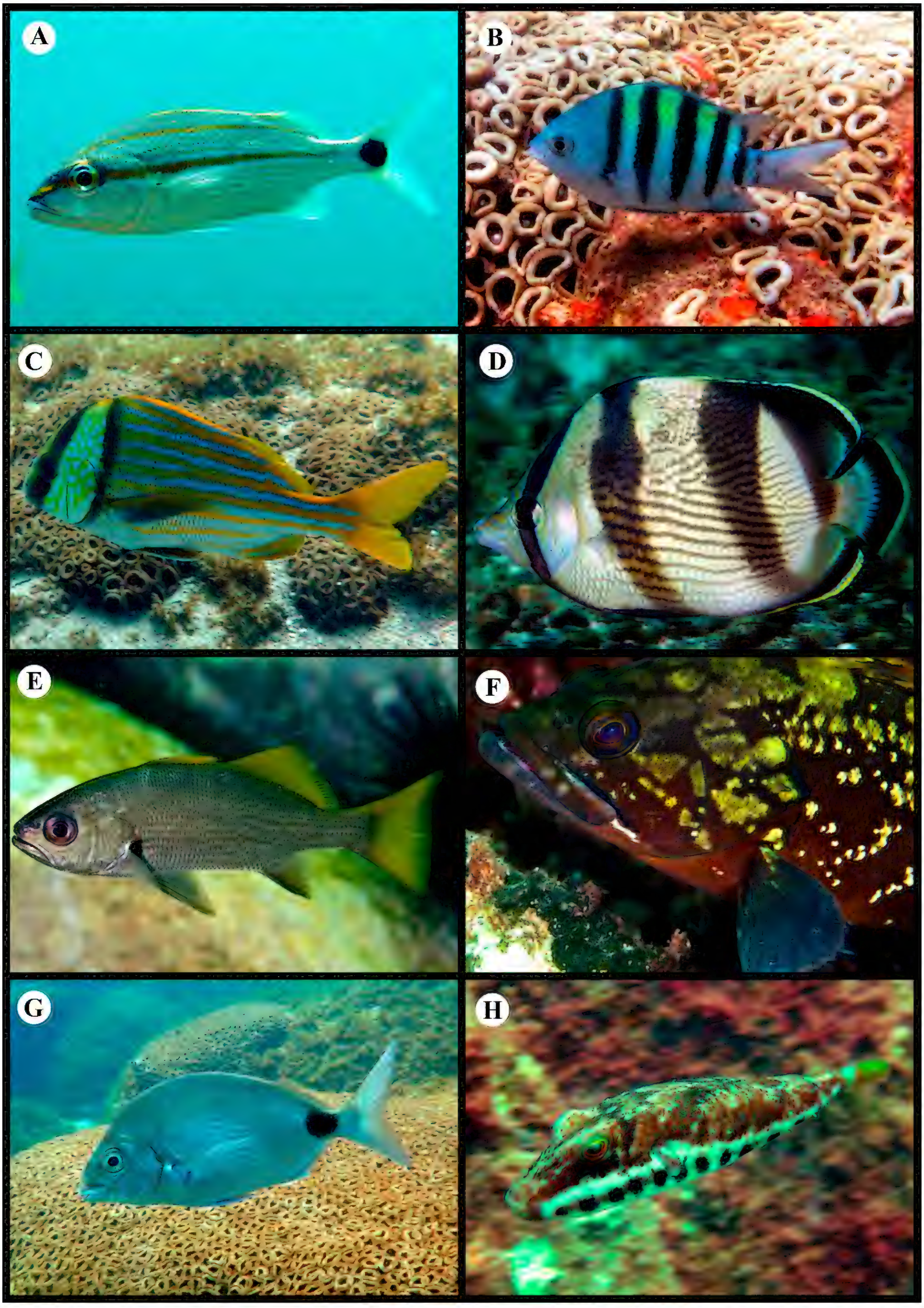

Figure 3. Examples reef fish considered "common" in reefs of Santa Catarina, Southern Brazil. (**A**) The Tomtate Grunt, *Haemulon aurolineatum*; (**B**) Sergeant Major, *Abudefduf saxatilis*; (**C**) Porkfish, *Anisotremus virginicus*; (**D**) Banded Butterflyfish, *Chaetodon striatus*; (**E**) Reef Croaker, *Odontoscion dentex*; (**F**) Dusky Grouper, *Epinephelus marginatus*; (**G**) South American Silver Porgy, *Diplodus argenteus*; (**H**) Bandtail Puffer, *Sphoeroides spengleri*.

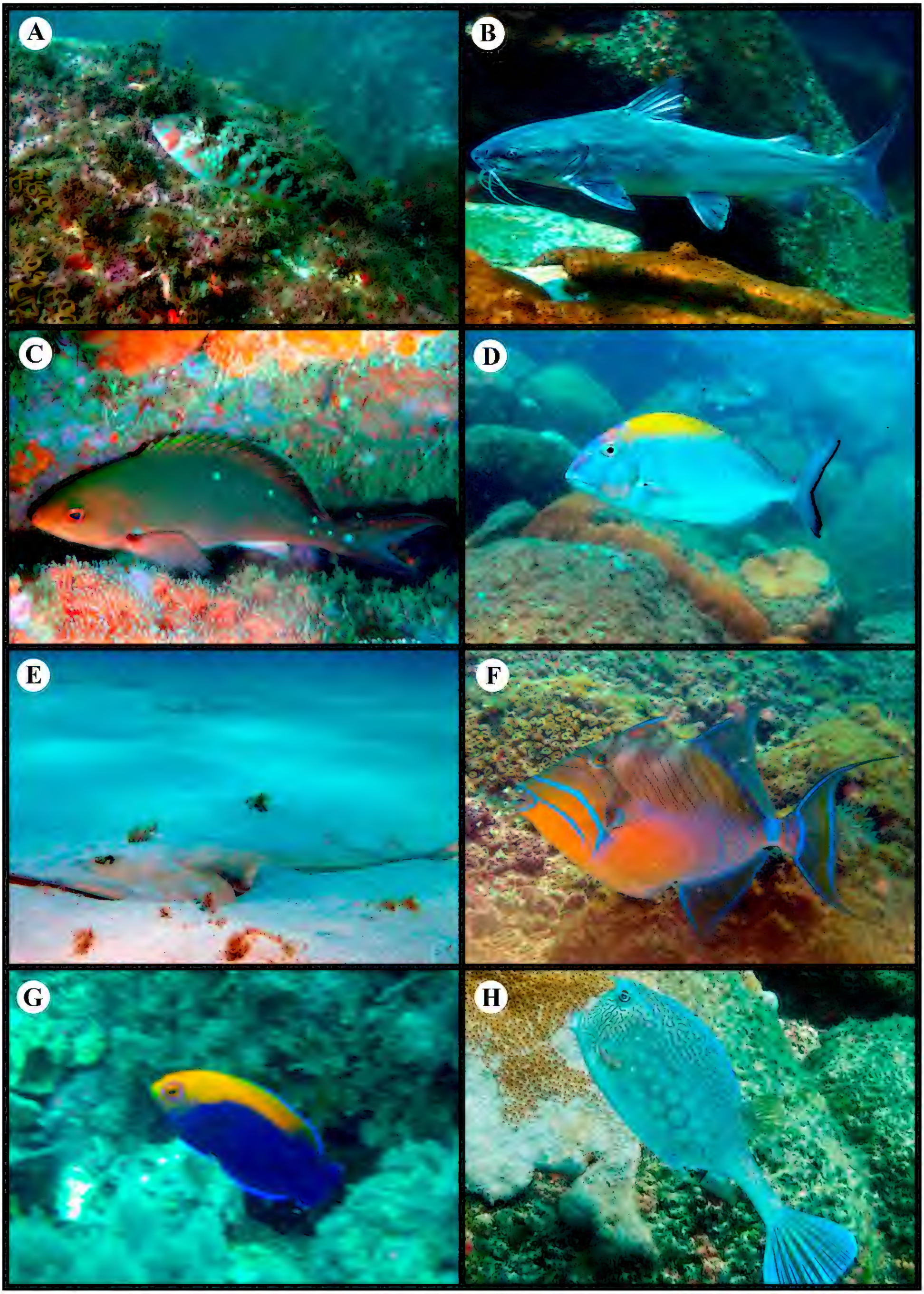

Figure 4. Examples of reef fish species considered as "rare"in reefs of Santa Catarina, Southern Brazil. (**A**) Emerald Parrotfish, *Nicholsina usta*; (**B**) Guri Sea Catfish, *Genidens genidens*; (**C**) Creole-fish, *Paranthias furcifer*; (**D**) Sheepshead Porgy, *Calamus penna*; (**E**) Brazilian Guitarfish, *Rhinobatos horkelii*; (**F**) Queen Triggerfish, *Balistes vetula*; (**G**) Flameback Angelfish, *Centropyge aurantonotus*; (**H**) Honeycomb Cowfish, *Acanthostracion polygonius*.

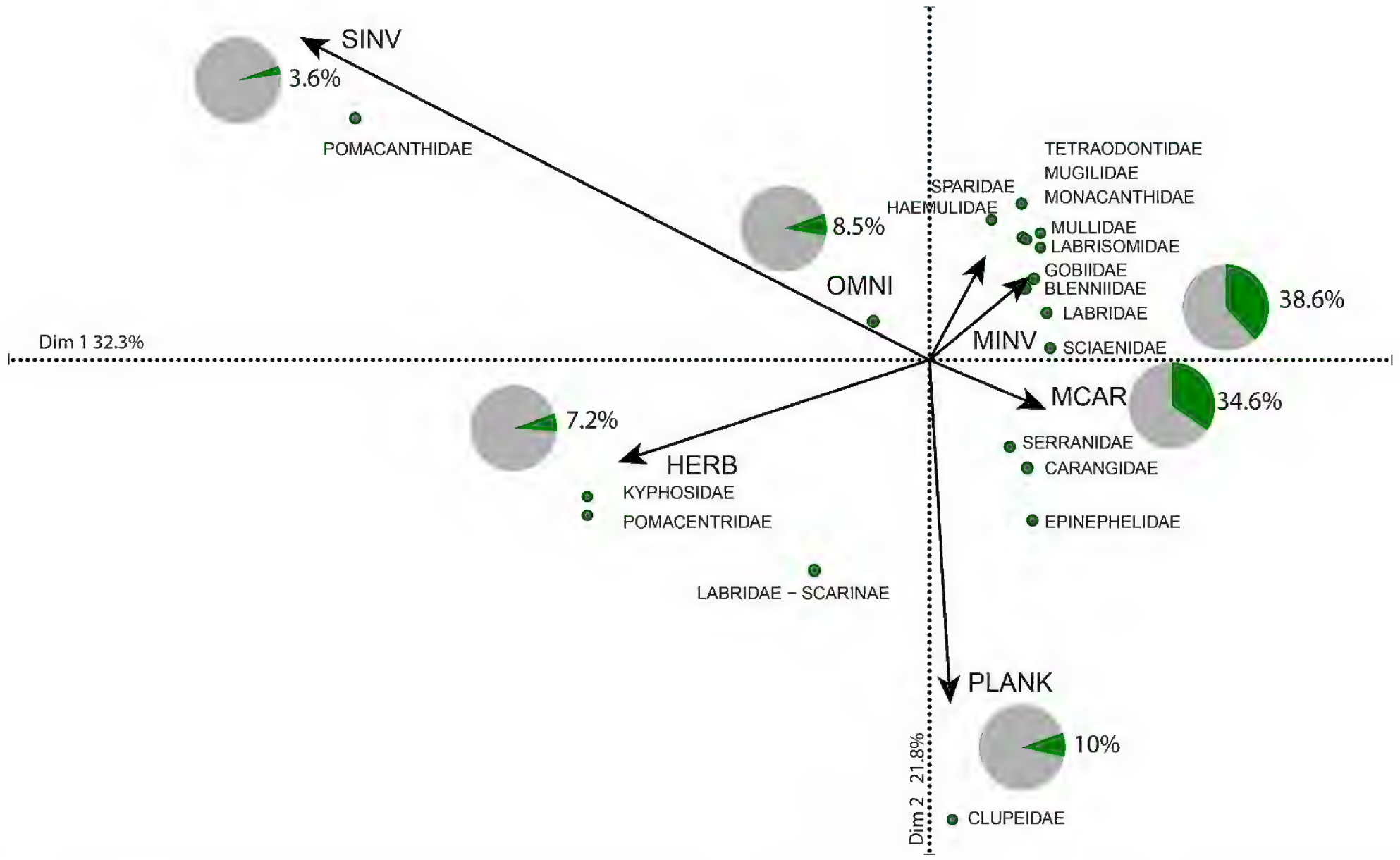

Figure 5. Correspondence analysis based on species richness showing the trophic structure of reef fish ichthyofauna in Santa Catarina's rocky reef systems. Vectors indicate the feeding habits of species: MINV = mobile invertebrate feeders, MCAR = macrocarnivores, PLANK = planktivores, OMNI = omnivores, HERB = herbivores/detritivores, SINV = sessile invertebrate feeders. Green circles mark the positions of the families. Grey/green circles represent the relative proportion of species for each trophic group.

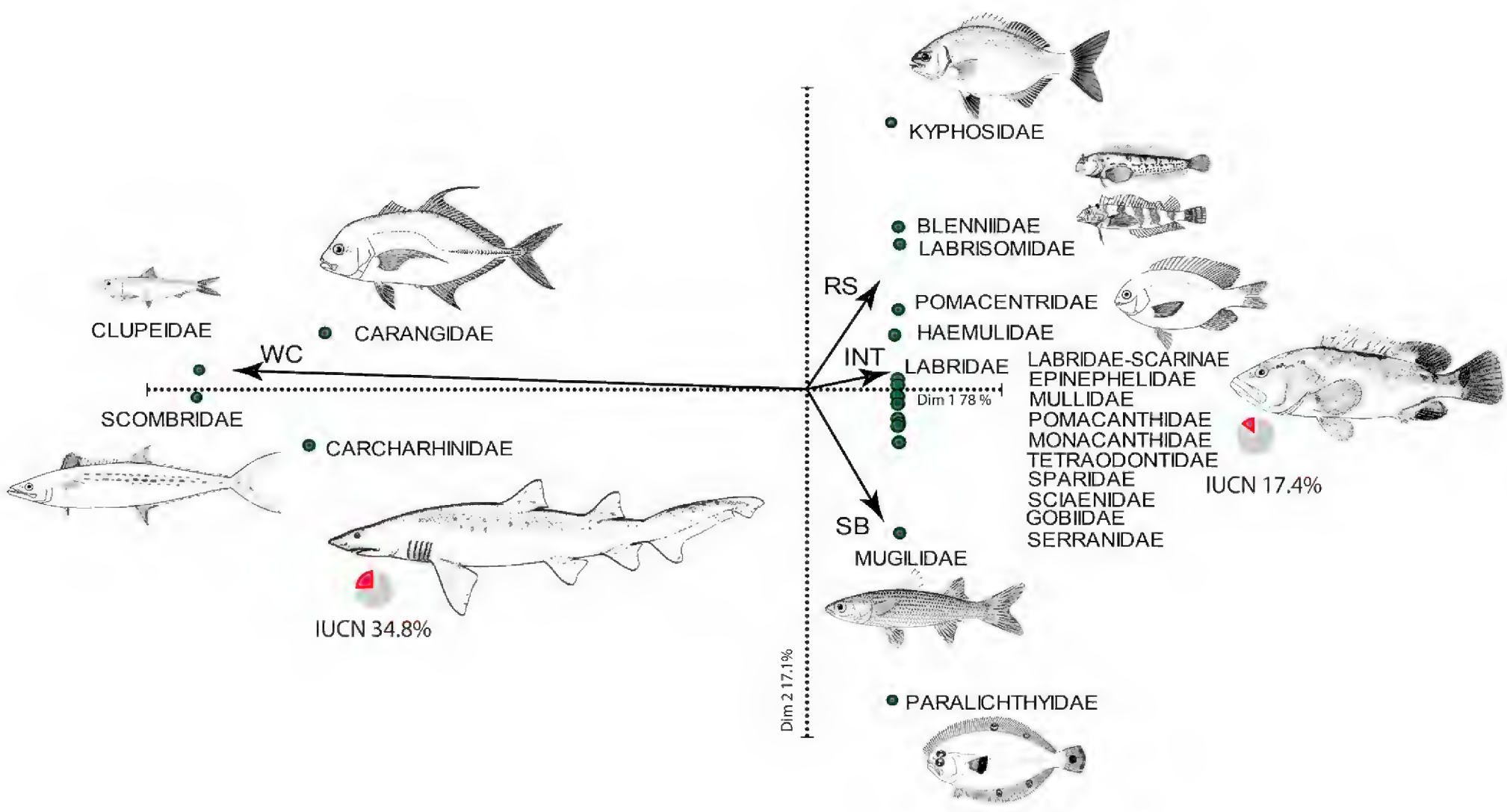

Figure 6. Habitat distribution of reef fish in Santa Catarina's rocky reef systems. The vectors indicate the reef's ecological zones: RS = Reef Slope zone, INT = interface, SB = sandy bottom, WC = water column. Green circles indicate the position of respective families in the rocky reef system (CA). Grey/red circles indicate the relative quantity of threatened species within the families of sharks, tunas and groupers, which are the most threatened groups.

americanus (Castelnau 1855); *Cantherhines macrocerus* (Hollard, 1853); *Chaetodon sedentarius* (Poeyi, 1860); *Chromis flavicauda* (Günther, 1880); *Clepticus brasiliensis* (Heiser, Moura & Robertson, 2000); *Decapterus punctatus* (Cuvier, 1829); *Gymnothorax vicinus* (Castelnau, 1855); *Herpetoichthys regius* (Richardson, 1848); *Muraena retifera* Goode & Bean, 1882 and *Stegastes partitus* (Poey, 1868). For *S. partitus*, this is the first documented record for Southwestern Atlantic waters, and for *H. regius* this is the first record for the coastal Southwestern Atlantic (Figure 7). For *Acanthurus monroviae* Steindachner, 1876, this is also the second record for Southwestern Atlantic waters. Details on the new records are given below (ordered alphabetically by Order and then Family).

Order Anguilliformes, Family Muraenidae

Gymnothorax vicinus (Castelnau, 1855) (Figure 7A). One individual was recorded at the approximate depth of 7 m, Arvoredo Marine Biological Reserve, Santa Catarina in 2008. *Remarks:* Previous southernmost record was the state of Paraná (Hackradt and Félix-Hackradt 2009).

Muraena retifera Goode & Bean, 1882 (Figure 7B). One adult individual was recorded at Xavier Island and another one at Aranhas Island in February 2015 both at the approximate depth of 8 m. *Remarks:* Previous southernmost record was the state of São Paulo (Carvalho-Filho 1999).

Order Anguilliformes, Family Ophichthidae

Herpetoichthys regius (Richardson, 1848) (Figure 7C and 7D). One large individual (around 90 cm) was recorded at Rancho Norte, Arvoredo Marine Biological Reserve in February 2014, at the approximate depth of 7 m, and another one smaller (around 40 cm) was recorded from Deserta Island, Arvoredo Marine Biological Reserve in May 2014.These two individuals were observed patrolling rhodolith banks that exist at these two locations. *Remarks:* These individuals represent the first record for the coastal Western Atlantic Ocean. Its native geographic range is the Eastern Atlantic, Ascension and Santa Helena Islands, but it has been recently reported to occur also on Saint Peter and Saint Paul Archipelago (Wirtzet al. 2015). Therefore this is the second report of this species for the Southwestern Atlantic and the first one for the coastal part of this region.

Order Perciformes, Family Acanthuridae

Acanthurus coeruleus Bloch & Schneider, 1801 (Figure 7E). One juvenile individual was recorded at the approximate depth of 8 m, Deserta Island, Arvoredo Marine Biological Reserve, Santa Catarina in 2010, and one adult (ca. 30 cm total length) was recorded at a depth of 12 m at Saco do Farol, Arvoredo Island in March 2014. *Remarks:* Previous southernmost record for this species wasin the state of São Paulo (Carvalho-Filho 1999; Moura et al. 1999).

Acanthurus monroviae Steindachner, 1876. One individual, an adult male, was recorded at the approximate depth of 7 m at Parcel da Deserta, Arvoredo Marine Biological Reserve, Santa Catarina in February 2015. *Remarks:* This individual represents the second record for the Western Atlantic Ocean, being previously recorded for Laje de Santos, in the state of São Paulo (Luiz et al. 2004, 2010). Its native range is in the Eastern Atlantic.

Family Apogonidae

Apogon americanus (Castelnau 1855) (Figure 7F). One individual was recorded at a depth of 10 m at Saco do Farol, Arvoredo Island in February 2014. *Remarks:* Previous southernmost record was in the state of São Paulo (Carvalho-Filho 1999).

Family Carangidae

Decapterus punctatus (Cuvier, 1829). Many individuals were seen and photographed at 10–15 m deep, at Deserta Island, Santa Catarina, 2015. *Remarks:* The previous southernmost record was in the state of São Paulo (Carvalho-Filho 1999).

Family Chaetodontidae

Chaetodon sedentarius Poey, 1860 (Figure 8A). One individual was recorded at the approximate depth of 9 m, Arvoredo Marine Biological Reserve, Santa Catarina in 2010. *Remarks:* Previous southernmost record was in the state of São Paulo (Carvalho-Filho 1999).

Family Labridae

Clepticus brasiliensis Heiser, Moura & Robertson, 2000 (Figure 8B). One individual was recorded at the approximate depth of 6 m, Deserta Island, Arvoredo Marine Biological Reserve, Santa Catarina, in April 2011. *Remarks:* The previous southernmost record was in the state of São Paulo (Carvalho-Filho 1999).

Family Pomacentridae

Chromis flavicauda (Günther, 1880)(Figure 8E). Three individuals were recorded at the approximate depth of 10 m, Xavier Island, Santa Catarina in February 2011. One of these individuals was resighted in April of the same year. *Remarks:* Previous southernmost record was in the state of São Paulo (Carvalho-Filho 1999).

Stegastes partitus (Poey, 1868) (Figure 8C and 8D). One individual was recorded at the approximate depth

of 6 m, Galé Island, Arvoredo Marine Biological Reserve, Santa Catarina in February 2013. *Remarks:* The individual recorded represents the first record for the Southern Atlantic Ocean. Its native range is in the Northwestern Atlantic, south to Venezuela (Cervigón 1993).

Order Tetraodontiformes, Family Monacanthidae

Cantherhines macrocerus (Hollard, 1853) (Figure 8F). One individualrecorded being cleaned by a juvenile of *Pomacanthus paru* at the approximate depth of 2 m at

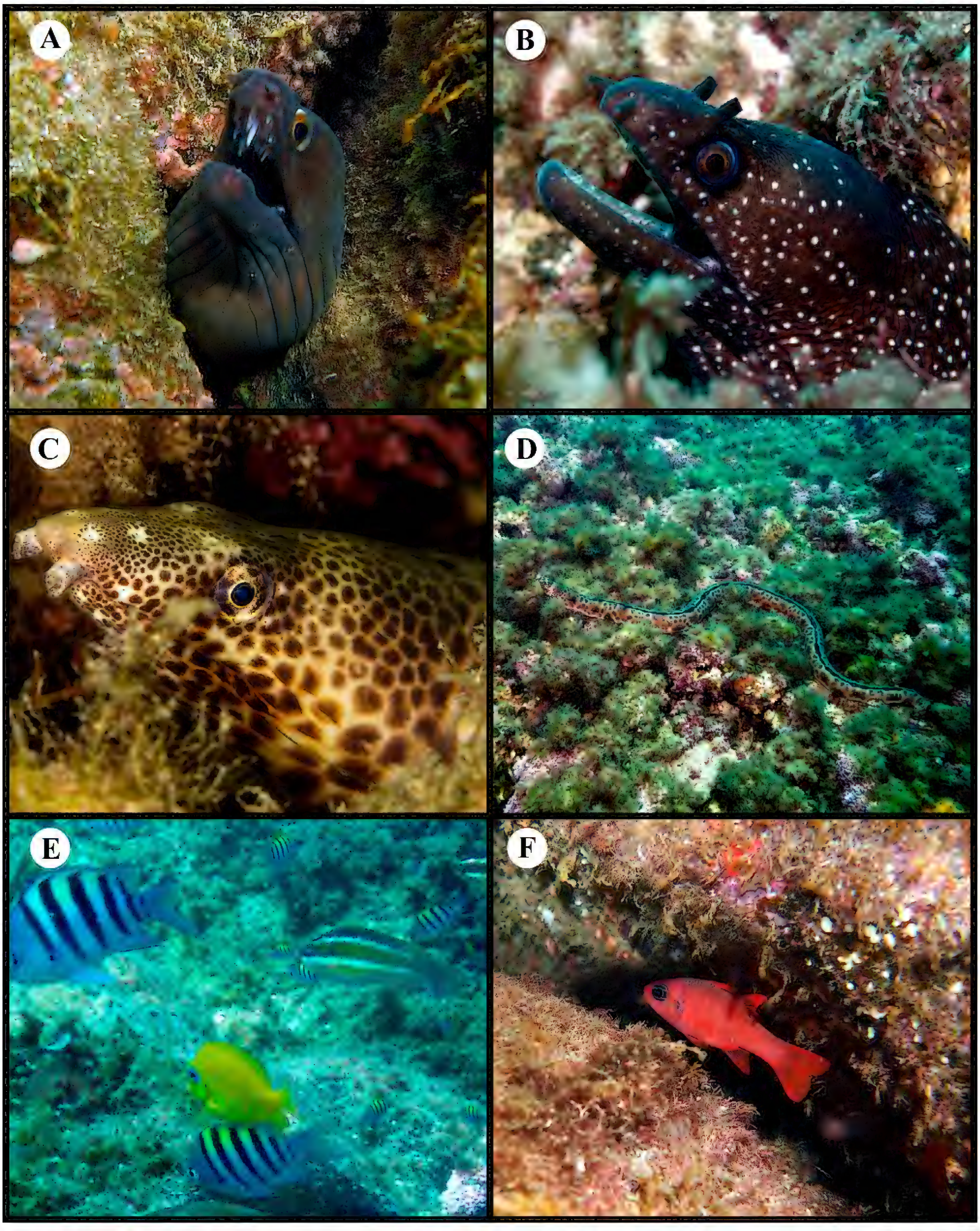

Figure 7. Examples of new records of reef fish species to the state of Santa Catarina, Southern Brazil. (**A**) Purplemouth Moray, *Gymnothorax vicinus*; (**B**) Reticulate Moray, *Muraena retifera*; (**C–D**) Ornate Snake Eel, *Herpetoichthys regius*; (**E**) Blue Tang Surgeonfish, *Acanthurus coeruleus*; (**F**) Brazilian Flamefish, *Apogon americanus.*

Praia da Sepultura, Bombinhas, Santa Catarina in March 2015. *Remarks:* Previous southernmost record was in the state of São Paulo (Carvalho-Filho 1999).

A growing number of reef fishes have been detected outside of their native range in the Atlantic (Freitas et al. 2013; Luiz et al. 2013), with at least three recent examples reaching south-southeastern Brazil: the Azores Chromis, *Chromis limbata* (Valenciennes, 1833), the West African Tang, *Acanthurus monroviae* Steindachner, 1876, and the Bannerfish, *Heniochus acuminatus* (Linnaeus, 1758). The first two species are known from the Eastern Atlantic and have reached the Brazilian coast after breaching the Mid-Atlantic Barrier (Luiz et al. 2004; Leite et al. 2009). The Bannerfish is distributed all over the Indo-Pacific and it is controversial whether its arrival in Brazil means a long dispersal via South Africa or an aquarium release (Luiz et al. 2014). From these three species, only *C. limbata* has successfully established populations in the Southwestern Atlantic (Anderson *et al.* pers. obs.). Of the new records presented by this work, the Bicolor Damselfish, *Stegastes partitus*, and the Ornate Snake

Figure 8. Examples of new records of reef fish species to the state of Santa Catarina, Southern Brazil. (**A**) Reef Butterflyfish, *Chaetodon sedentarius*; (**B**) Brazilian Creolewrasse, *Clepticus brasiliensis*; (**C–D**) Bicolor Damselfish, *Stegastes partitus*; (**E**) Cobalt Chromis, *Chromis flavicauda*; (**F**) Whitespotted Filefish, *Cantherhines macrocerus*.

Eel, *Herpetoichthys regius,* are considerably unnusual not only because they expand species´ known geographic range by several thousands of kilometers, but also because of large environmental differences between their place of origin and the Santa Catarina coast.

The Bicolor Damselfish is a Northwestern Atlantic endemic species, ranging from Florida to Venezuela (Humannn and Deloach 2014).This species is heavily associated with coral reefs, even when occurs in cooler upwelling Caribbean locations, such as the Venezuelan coast, and therefore its occurrence on a transitional zone with no coral reef builders (see Castro and Pires 2001, for distribution of coral reefs in Brazil) is at least intriguing. Introduction via ship's ballast water is unlikely because most fish larvae do not survive for long periods in that environment (Carlton 1985). Aquarium trade is also unlikely because this species is not commonly exported from the Caribbean, and there are no records of it being commercialized in the study region. The building of new platforms and intense oil industry activity seems to be the more likely form of artificial introduction because movement of these structures is intensifying worldwide and adults from some species are known to have been transported through those means (Dulcic and Dragicevic 2013). However,the possibility of a natural colonization cannot be dismissed and only future monitoring of this species presence along the Brazilian coast could clarify this range extension causes.

The Ornate Snake Eel is considered to be endemic to the Eastern Atlantic and islands of Santa Helena, Ascension and Saint Paul´s Rocks (Wirtz et al. 2015), none of which is located less than 3,700 km from Santa Catarina coast. Although no ecological information concerning this species was found in the literature, in the two occasions it was encountered in Santa Catarina, it wandered through shallow rhodolith beds. Contrary to *Stegastes partitus*, it is highly unlikely that this species was artificially introduced at Santa Catarina coast and, so, natural dispersal might account for its presence there. The first and most likely hypothesis is that it is also present in other places along the Brazilian coast, but was overlooked due to its cryptic nature and, especially, to its poorly sampled habitat (rhodolith beds), for which Santa Catarina is the southernmost limit (Gherardi 2004; Pascelli et al. 2013). The alternative hypothesis is that it represents another case of extreme dispersal event driven by Brazil Current.

Zoogeography, tropical affinities and remarkable absences

Most of the recorded species (162 species or 58.3%) are known to occur only in the Western Atlantic Ocean. Species occurring on both sides of the Atlantic Ocean (Western and Eastern Atlantic, 60 species) total 21.6% of the richness. Circumtropical cosmopolitan species (24 species) totaling 8.6% and 15 species were considered circumglobal cosmopolitans species (5.4%) (Floeter et al. 2008; Froese and Pauly 2014).

Also, 23 of the recorded species (8.3%) are endemic to the Brazilian Province (Figure 9), a little lower than the number for the whole Brazilian coast (10.5%; Floeter et al. 2008). This might be due to the fact that many endemic Brazilian species possess tropical affinities, with some attaining their southern limit of occurrence northwards, in the states of Rio de Janeiro or São Paulo (Carvalho-Filho 1999; Luiz et al. 2009). In fact, all these localities are part of the Southwestern Atlantic Shelf (Matano et al. 2010) and are affected by seasonal cool waters that can restrict the occurrence of tropical species. Examples of endemic tropical species that do not reach Santa Catarina are *Haemulon squamipinna*, *Halichoeres penrosei*, and *Lutjanus alexandrei*, just to mention a few.

Despite some tropical reef fish species that do not occur southward to Santa Catarina state, many do and overall its faunal domain can be considered tropical with the enrichment of temperate elements. These temperate elements are, however, less important for species compostion than its relatively high latitude would predict. This is particularly true when comparing to southeastern region reefs that are heavily affected by upwelling, such as Arraial do Cabo and Ilha Rasa in Rio de Janeiro state, and Laje de Santos in São Paulo state (Luiz et al. 2008; Carvalho-Filho et al. 2009; Bertonciniet al. 2013). In these places, temperate species that occur in deep waters throughout the Brazilian shelf have been recorded for shallow waters associated with frequent upwelling events.

This upwelling of deep water/temperate species includes the occurrence of *Dules auriga* Cuvier, 1829, *Pagrus pagrus* (Linnaeus, 1758), *Pinguipes brasilianus* Cuvier, 1829, *Halichoeres sazimai* Luiz, Ferreira & Rocha, 2009, *Acanthistius brasilianus* (Cuvier, 1828) and *Pronotogrammus martinicensis* (Guichenot, 1868) for depths shallower than 40 m (Irigoyen et al. 2008; Luiz et al. 2008; Carvalho-Filho et al. 2009; Bertonciniet al. 2013). The first three species are common in shallow Argentine reefs (Irigoyen and Galván 2010), *H. sazimai* have its southern distribution limit at Santa Catarina (Barneche et al. 2009), but *P. martinicensis* have its only known shallow water population in these upwelling areas along the "Arc of Capricorn" (Carvalho-Filho et al. 2009) and *A. brasilianus* in this region and also Uruguay (Irigoyen et al. 2008; Irigoyen et al. 2010). *Dules auriga* is commonly found in Santa Catarina southward from Xavier Island (27°36′ S, 048°23′ W), while *H. sazimai* and *Pagrus pagrus* are rare or uncommon, even in shallow habitats in the southern part of the state (RM pers obs). But the most intriguing issue is that *Pinguipes brasilianus*, *Acanthistius brasilianus* and *Pronotogrammus martinicensis* have never been recorded for the shallow reefs despite relatively wide geographic sampling and

the fact that the higher latitude reefs of Santa Catarina are exposed to temperatures sometimes as low as these upwelling places northward. Recently, *Pronotogrammus martinicensis* was recorded from Santa Catarina at a depth of 130 m, associated with the sunken german submarine U-513 (Figure 10). This suggests that other temperate species might also be present in deep reefs, and may be confirmed by more observations and further sampling of these habitats.

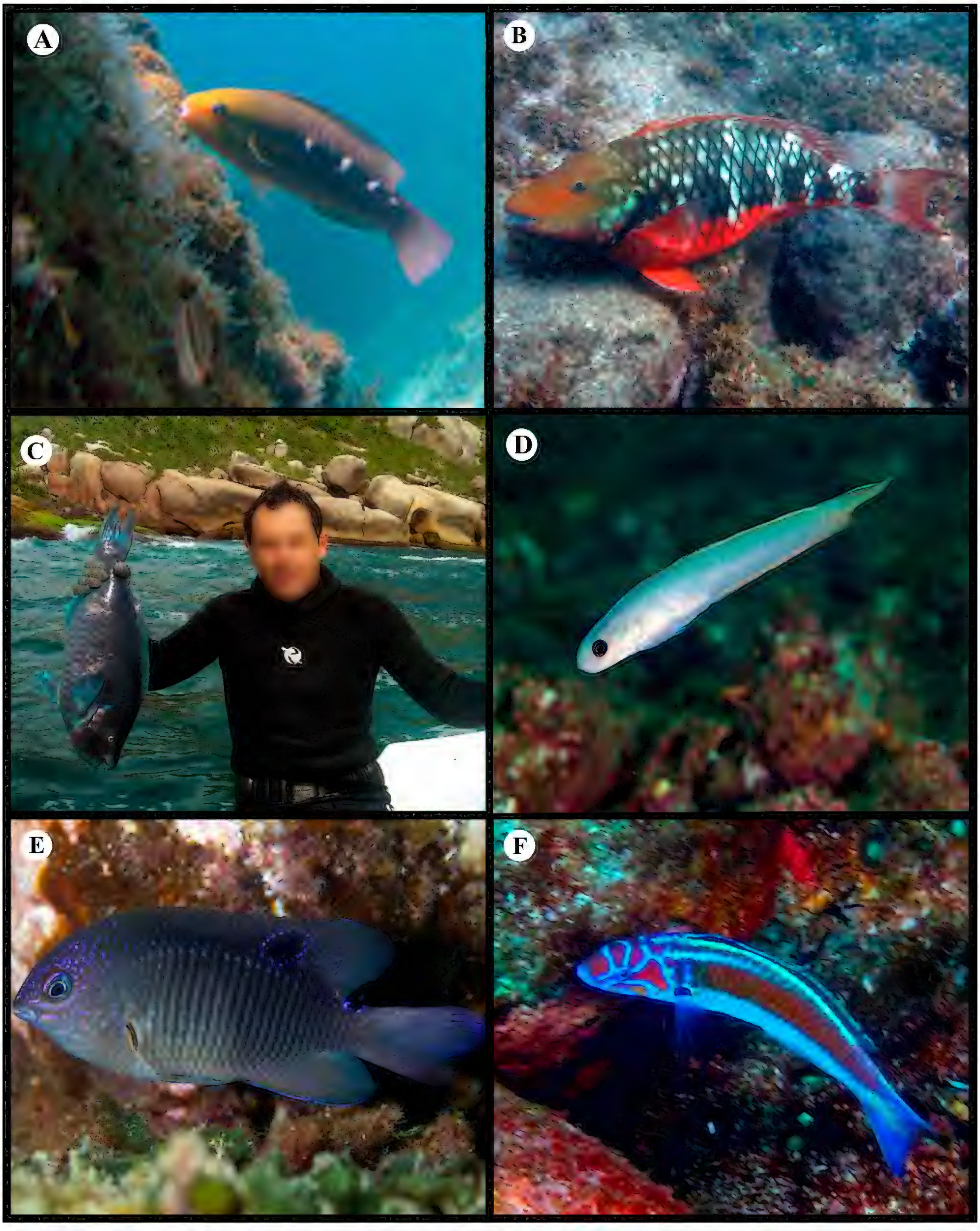

Figure 9. Examples of endemic Brazilian reef fish species observed in reefs of Santa Catarina, Southern Brazil. (**A**) Striped Parrotfish, *Scarus zelindae*; (**B**) Reef Parrotfish, *Sparisoma amplum*; (**C**) Greenback Parrotfish, *Scarus trispinosus*; (**D**) Brazilian Dartfish, *Ptereleotris randalli*; (**E**) Brazilian Dusky Damselfishes, *Stegastes fuscus*; (**F**) Noronha Wrasse, *Thalassoma noronhanum*.

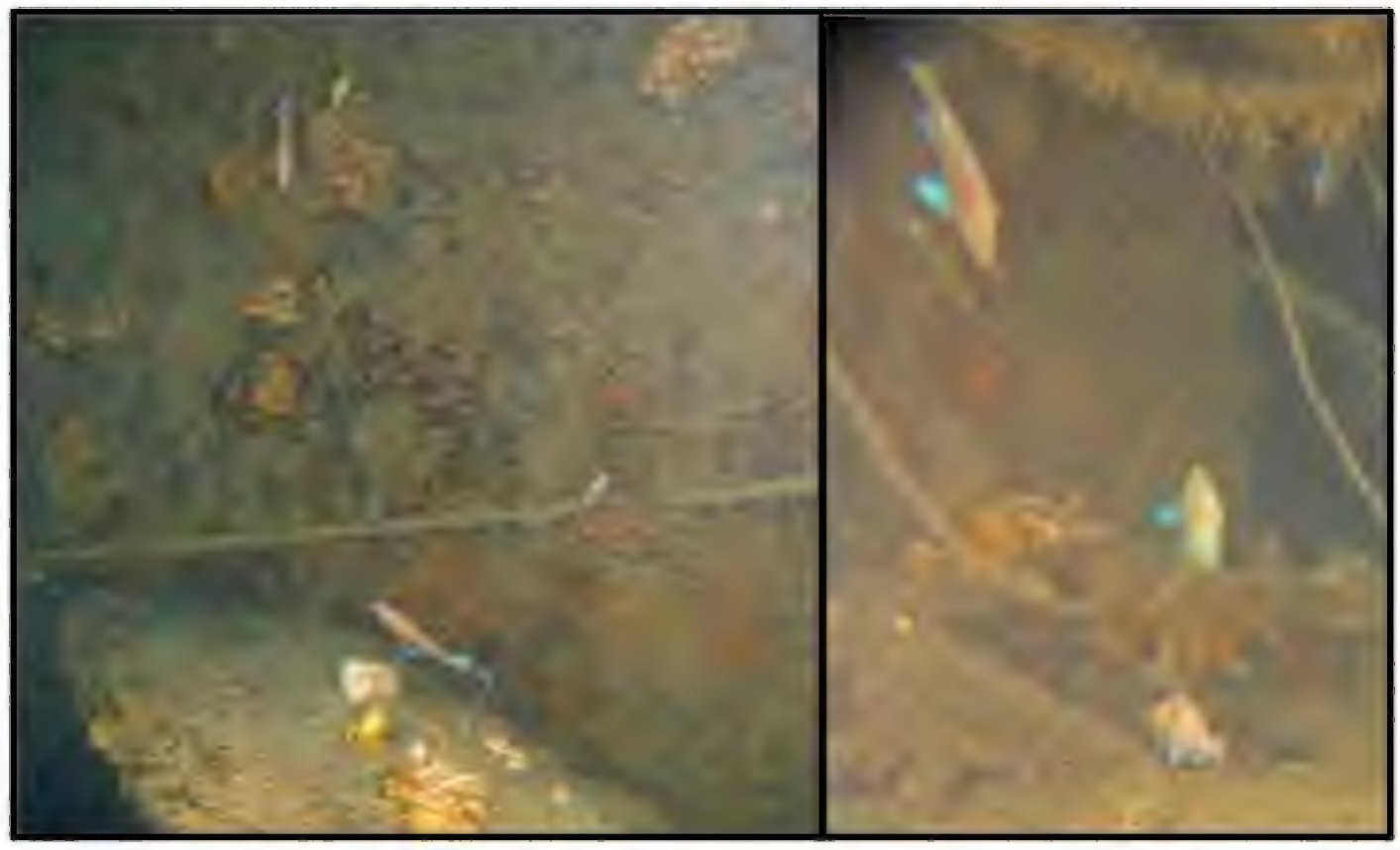

Figure 10. *Pronotogrammus martinicensis* recorded at 130 m depth associated with the sunken German submarine U-513 off Santa Catarina, Southern Brazil.

Conclusions

The ichthyofauna of Santa Catarina state is mostly characterized by tropical species brought from the northern warm waters by oceanic currents. Nevertheless, the cold waters in the austral winter sea surface temperature can affect the survival of such species, leading to the extirpation of populations (cf. Bohnsack 1983; Hsieh et al. 2008). The unusual new records presented in the present work indicates that long-term monitoring studies will allow a better understanding of connectivity patterns along the coast of Santa Catarina as well as the possible establishment of new populations at their southernmost limit of distribution. Of interest also are cold-water related species whose reasons for the disjunct observed distributions, which exclude Santa Catarina, are not clear. Further sampling efforts on deeper habitats might reveal novel insights concerning their distribution status.

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Appendix 1

Table A1. Vouchers specimens from MZUSP (Museu de Zoologia da Universidade de São Paulo, Brazil); vouchers from NEMAR (Center of Sea Studies of Universidade Federal de Santa Catarina UFSC / Brazil); vouchers from CIUFSC (Ichthyological collection of Universidade Federal de Santa Catarina, UFSC / Brazil); voucher from USNM (National Museum of Natural History; Smithsonian Institution; Washington, DC) and voucher from UFRGS (Universidade Federal do Rio Grande do Sul). Names in parenthesis are the previous recognized as valid for the area.

Family	Species	MZUSP	CIUFSC	NEMAR
Acanthuridae	*Acanthurus bahianus*	MZUSP55397	CUFSC1391	-
Acanthuridae	*Acanthurus chirurgus*	MZUSP55341	-	-
Ariidae	*Cathorops spixii*	-	CIUFSC251	ARII 1982.001.191
Ariidae	*Genidens barbus*	-	CIUFSC1079	ARII 1992.029.219
Ariidae	*Genidens genidens*	-	CIUFSC1329	ARII 1982.002.192
Balistidae	*Balistes capriscus*	-	CIUFSC814	BALIS 1981.002.1186
Batrachoididae	*Porichthys porosissimus*	-	CIUFSC779	BATRA 1982.001.101
Belonidae	*Strongylura marina*	-	-	BELO 1992.011.138
Blenniidae	*Hypleurochilus fissicornis*	MZUSP55318	-	BLEN 1984.002.121
Blenniidae	*Hypleurochilus pseudoequipinnis*	MZUSP55320	-	-
Blenniidae	*Hypsoblennius invemar*	MZUSP55319	-	-
Blenniidae	*Ophioblennius trinitatis*	MZUSP55452	-	-
Blenniidae	*Parablennius marmoreus*	MZUSP55451	-	-
Blenniidae	*Parablennius pilicornis*	-	CIUFSC605	BLEN 1989.004.123
Blenniidae	*Scartella cristata*	MZUSP55440	CIUFSC1574	BLEN 1979.001.120
Bothidae	*Bothus ocellatus*	MZUSP55378	-	-
Callionymidae	*Callionymus bairdi*	MZUSP55455	-	-
Carangidae	*Caranx crysos*	MZUSP55363	-	-
Carangidae	*Caranx hippos*	-	CIUFSC1311	CARA 1984.012.416
Carangidae	*Caranx latus*	-	CIUFSC734	CARA 1989.051.455
Carangidae	*Chloroscombrus chrysurus*	-	CIUFSC1309	CARA 1980.002.406
Carangidae	*Oligoplites saliens*	-	-	CARA 1988.033.437
Carangidae	*Oligoplites saurus*	-	CIUFSC727	CARA 2005.072.476
Carangidae	*Pseudocaranx dentex*	MZUSP55438	-	-
Carangidae	*Selene setapinnis*	-	CIUFSC379	CARA 2003.073.477
Carangidae	*Selene vomer*	-	CIUFSC371	-
Carangidae	*Trachinotus carolinus*	-	CIUFSC723	CARA 2005.077.713
Carangidae	*Trachinotus falcatus*	-	CIUFSC735	CARA 1988.045.449
Carangidae	*Trachinotus marginatus*	-	-	CARA 1989.056.460
Carcharhinidae	*Carcharhinus brevipinna*	-	CIUFSC1357	-
Carcharhinidae	*Carcharhinus isodon*	-	CIUFSC1139	-
Carcharhinidae	*Carcharhinus obscurus*	-	CIUFSC 468	-
Carcharhinidae	*Carcharhinus plumbeus*	-	CIUFSC1162	-
Carcharhinidae	*Carcharhinus porosus*	-	CIUFSC481	-
Carcharhinidae	*Carcharhinus signatus*		CIUFSC1152	-
Carcharhinidae	*Rhizoprionodon lalandii*	-	CIUFSC1376	-
Centropomidae	*Centropomus undecimalis*	-	CIUFSC679	CENTRO 1998.018.157
Centropomidae	*Centropomus parallelus*	-	CIUFSC1513	CENTRO 2002.027.166
Chaenopsidae	*Emblemariopsis signifer*	MZUSP55448	CIUFSC608	-
Chaetodontidae	*Chaetodon striatus*	MZUSP55342	CIUFSC1370	-
Chaetodontidae	*Prognathodes guyanensis*	MZUSP49096	-	-

Continued

Table A1. *Continued.*

Family	Species	MZUSP	CIUFSC	NEMAR
Clupeidae	*Harengula clupeola*	-	CIUFSC545	CLUP 1980.001.788
Clupeidae	*Opisthonema oglinum*	-	CIUFSC55	CLUP 2005.042.829
Clupeidae	*Sardinella brasiliensis*	-	CIUFSC1064	CLUP 1982.004.491
Dactylopteridae	*Dactylopterus volitans*	MZUSP55431	-	DACTY 1989.003.390
Dactyloscopidae	*Dactyloscopus crossotus*	MZUSP46668	-	-
Dasyatidae	*Dasyatis hypostigma (say)*	-	CIUFSC511	-
Diodontidae	*Chilomycterus reticulatus*	-	CIUFSC259	-
Diodontidae	*Chilomycterus spinosus spinosus*	MZUSP940	-	DIODS 1999.002.1104
Echeneidae	*Echeneis naucrates*	-	CIUFSC578	-
Eleotridae	*Eleotris pisonis*	-	CIUFSC1652	-
Ephippidae	*Chaetodipterus faber*	MZUSP13314	CIUFSC771	EPHI 1988.006.401
Epinephelidae	*Epinephelus marginatus*	MZUSP55334	CIUFSC797	-
Epinephelidae	*Hyporthodus niveatus*	-	CIUFSC1063	-
Epinephelidae	*Mycteroperca acutirostris*	MZUSP55325	-	-
Epinephelidae	*Mycteroperca bonaci*	MZUSP55423	-	-
Fistulariidae	*Fistularia petimba*	-	CIUFSC778	-
Fistulariidae	*Fistularia tabacaria*	-	CIUFSC530	FISTU 1993.001.787
Gerreidae	*Diapterus auratus*	-	CIUFSC115	GERRE 2010.065.1031
Gerreidae	*Diapterus rhombeus*	-	CIUFSC62	GERRE 1997.041.1007
Gerreidae	*Eucinostomus argenteus*	-	CIUFSC639	GERRE 1988.024.990
Gerreidae	*Eucinostomus gula*	-	CIUFSC247	GERRE 1987.019.985
Gerreidae	*Eucinostomus melanopterus*	-	CIUFSC1816	GERRE 1988.010.976
Gerreidae	*Eugerres brasilianus*	-	CIUFSC1555	GERRE 1984.008.974
Gobiesocidae	*Gobiesox barbatulus (strumosus)*	-	CIUFSC1383	GOBIE 1993.001.111
Gobiesocidae	*Tomicodonaustralis (fasciatus)*	USNM 88042*	CIUFSC536	-
Gobiidae	*Barbulifer ceuthoecus*	MZUSP55331	-	-
Gobiidae	*Bathygobius soporator*	-	CIUFSC675	GOBI 1986.019.1051
Gobiidae	*Coryphopterus glaucofraenum*	MZUSP55332	-	-
Gobiidae	*Ctenogobius stigmaticus*	-	-	GOBI 1988.036.1068
Gobiidae	*Elacatinus figaro*	MZUSP49139	-	-
Gobiidae	*Microgobius meeki*	-	-	GOBI 1982.002.1034
Haemulidae	*Anisotremus surinamensis*	MZUSP67863	CIUFSC628	HAEMU 1993.017.1156
Haemulidae	*Anisotremus virginicus*	-	CIUFSC647	-
Haemulidae	*Haemulon aurolineatum*	MZUSP55357	CIUFSC645	HAEMU 1984.004.1143
Haemulidae	*Haemulon bonariense*	MZUSP55354	-	-
Haemulidae	*Orthopristis ruber*	-	CIUFSC396	HAEMU 1988.006.1145
Haemulidae	*Pomadasys corvinaeformis*	-	CIUFSC400	HAEMU 2010.024.1163
Hemiramphidae	*Hemiramphus brasiliensis*	-	CIUFSC780	HEMI 1988.004.1170
Hemiramphidae	*Hyporhamphus unifasciatus*	-	CIUFSC1070	HEMI 1986.001.1167
Holocentridae	*Holocentrus adscensionis*	MZUSP55390	CIUFSC762	-
Holocentridae	*Myripristis jacobus*	MZUSP55388	CIUFSC759	-
Kyphosidae	*Kyphosus vaigiensis*	MZUSP55335	CIUFSC753	-
Labridae	*Bodianus pulchellus*	MZUSP55398	-	-
Labridae	*Halichoeres poeyi*	-	CIUFSC823	-
Labridae	*Xyrichtys novacula*	-	CIUFSC1058	-
Labridae -Scarine	*Cryptotomus roseus*	MZUSP55425	-	-
Labrisomidae	*Labrisomus cricota*	MZUSP55339	-	-
Labrisomidae	*Labrisomus nuchipinnis*	MZUSP55379	CIUFSC599	LABRE 1994.001.1166
Labrisomidae	*Malacoctenus aff. triangulatus*	MZUSP55450	-	-
Labrisomidae	*Starksia brasiliensis*	MZUSP55367	-	-
Lutjanidae	*Lutjanus analis*	-	-	LUTJA 1989.002.1178
Lutjanidae	*Lutjanus jocu*	-	-	LUTJA 1987.001.1177
Malacanthidae	*Malacanthus plumieri*	MZUSP55430	-	-
Monacanthidae	*Monacanthus ciliatus*	-	-	MONA 1992.006.1192
Monacanthidae	*Stephanolepis hispidus*	MZUSP55326	CIUFSC815	MONA 1987.001.1187
Mugilidae	*Mugil curema*	-	CIUFSC1067	MUGI 1986.001.716
Mugilidae	*Mugil liza*	-	CIUFSC1967	MUGI 1987.010.725
Mullidae	*Pseudupeneus maculatus*	MZUSP55344	CIUFSC810	-
Muraenidae	*Echidna catenata*	MZUSP16623	-	-
Muraenidae	*Gymnothorax moringa*	-	CIUFSC556	-
Muraenidae	*Gymnothorax ocellatus*	-	CIUFSC541	MURAE 1984.001.1199

Continued

Table A1. *Continued.*

Family	Species	MZUSP	CIUFSC	NEMAR
Muraenidae	*Gymnothorax vicinus*	-	CIUFSC554	-
Narcinidae	*Narcine brasiliensis*	-	CIUFSC576	NARCI 1991.001.1279
Ogcocephalidae	*Ogcocephalus vespertilio*	MZUSP55433	CIUFSC575	OGCOC 1990.001.1276
Ophichthidae	*Myrichthys breviceps*	MZUSP55337	-	-
Ophichthidae	*Myrichthys ocellatus*	-	CIUFSC557	-
Ophidiidae	*Ophidion holbrooki*	-	CIUFSC1524	-
Ostraciidae	*Acanthostracion quadricornis*	MZUSP49101	CIUFSC531	-
Ostraciidae	*Lactophrys trigonus*	MZUSP55428	-	OSTRA 2001.001.1124
Paralichthyidae	*Paralichthys brasiliensis*	-	CIUFSC437	-
Paralichthyidae	*Syacium micrurum*	-	CIUFSC806	-
Pempheridae	*Pempheris schomburgki*	-	CIUFSC1060	-
Polynemidae	*Polydactylus virginicus*	-	-	POLY 2011.001.1218
Pomacanthidae	*Holacanthus ciliaris*	MZUSP55392	CIUFSC1061	-
Pomacanthidae	*Pomacanthus paru*	MZUSP55458	CIUFSC822	-
Pomacentridae	*Abudefduf saxatilis*	-	CIUFSC1368	POMAC 1991.001.1112
Pomacentridae	*Chromis jubauna*	MZUSP55432	-	-
Pomacentridae	*Chromis multilineata*	-	CIUFSC1059	-
Pomacentridae	*Stegastes fuscus*	MZUSP55343	CIUFSC620	-
Pomacentridae	*Stegastes pictus*	MZUSP55346	-	-
Pomacentridae	*Stegastes variabilis*	MZUSP55400	CIUFSC610	-
Pomatomidae	*Pomatomus saltatrix*	-	CIUFSC1545	POMA 1991.018.1101
Priacanthidae	*Cookeolus japonicus*	-	-	PRIAC 2005.002.1174
Priacanthidae	*Priacanthus arenatus*	-	CIUFSC769	PRIAC 2011.004.1176
Rachycentridae	*Rachycentron canadum*	-	CIUFSC1491	-
Rhinobatidae	*Rhinobatos percellens*	-	-	RHINO 2005.002.1279
Rhinobatidae	*Zapteryx brevirostris*	-	CIUFSC503	RHINO 2005.003.1280
Sciaenidae	*Menticirrhus americanus*	-	CIUFSC1965	SCIA 1999.110.612
Sciaenidae	*Menticirrhus littoralis*	-	CIUFSC683	SCIA 1991.100.592
Sciaenidae	*Micropogonias furnieri*	-	CIUFSC1831	SCIA 1988.084.576
Sciaenidae	*Odontoscion dentex*	MZUSP55345	CIUFSC710	-
Sciaenidae	*Pareques acuminatus*	MZUSP55386	CIUFSC601	-
Scombridae	*Scomberomorus brasiliensis*	-	-	SCOMB 2011.001.1194
Scorpaenidae	*Scorpaena isthmensis*	-	-	SCORP 1982.001.1136
Scorpaenidae	*Scorpaena plumieri*	-	CIUFSC1373	SCORP 1987.002.1137
Serranidae	*Diplectrum formosum*	-	-	SERRA 1986.003.1285
Serranidae	*Diplectrum radiale*	-	-	SERRA 1982.001.1283
Serranidae	*Rypticus randalli*	MZUSP46648(1)	-	-
Serranidae	*Serranus flaviventris*	MZUSP55429	-	-
Sparidae	*Archosargus rhomboidalis*	-	CIUFSC1072	SPAR 1989.012.774
Sparidae	*Calamus pennatula*	MZUSP69960	-	-
Sparidae	*Diplodus argenteus*	MZUSP66545	CIUFSC1366	SPAR 1988.006.768
Sparidae	*Pagrus pagrus*	MZUSP70093	CIUFSC624	-
Sphyraenidae	*Sphyraena guachancho*	-	CIUFSC1840	SPHYR 1983.001.165
Sphyraenidae	*Sphyraena tome*	-	UFRGS 04429	-
Sphyrnidae	*Sphyrna lewini*	-	CIUFSC1134	-
Sphyrnidae	*Sphyrna zygaena*	-	CIUFSC1155	-
Syngnathidae	*Hippocampus patagonicus*	-	CIUFSC315	-
Syngnathidae	*Hippocampus reidi*	MZUSP55456	-	SYNG 1981.001.488
Syngnathidae	*Microphis lineatus*	-	CIUFSC275	-
Syngnathidae	*Sgnathus folleti*	-	-	SYNG 1989.002.489
Synodontidae	*Synodus bondi (foetens)*	-	-	SYNO 1983.001.478
Tetraodontidae	*Canthigaster figueiredoi*	MZUSP55355	-	-
Tetraodontidae	*Lagocephalus laevigatus*	-	CIUFSC1365	TETRA 1991.019.1238
Tetraodontidae	*Sphoeroides greeleyi*	-	CIUFSC245	TETRA 1980.001.1220
Tetraodontidae	*Sphoeroides spengleri*	MZUSP55338	CIUFSC552	TETRA 2010.031.1250
Tetraodontidae	*Sphoeroides testudineus*	-	CIUFSC388	TETRA 1980.004.1223
Tetraodontidae	*Sphoeroides tyleri*	-	-	TETRA 2004.028.1247
Triglidae	*Prionotus nudigula*	-	-	TRIGL 2010.024.1275
Triglidae	*Prionotus punctatus*	-	CIUFSC1966	TRGL 1989.017.1268

* *Tomicodon australis* holotype is from São Francisco do Sul, SC, Brazil.